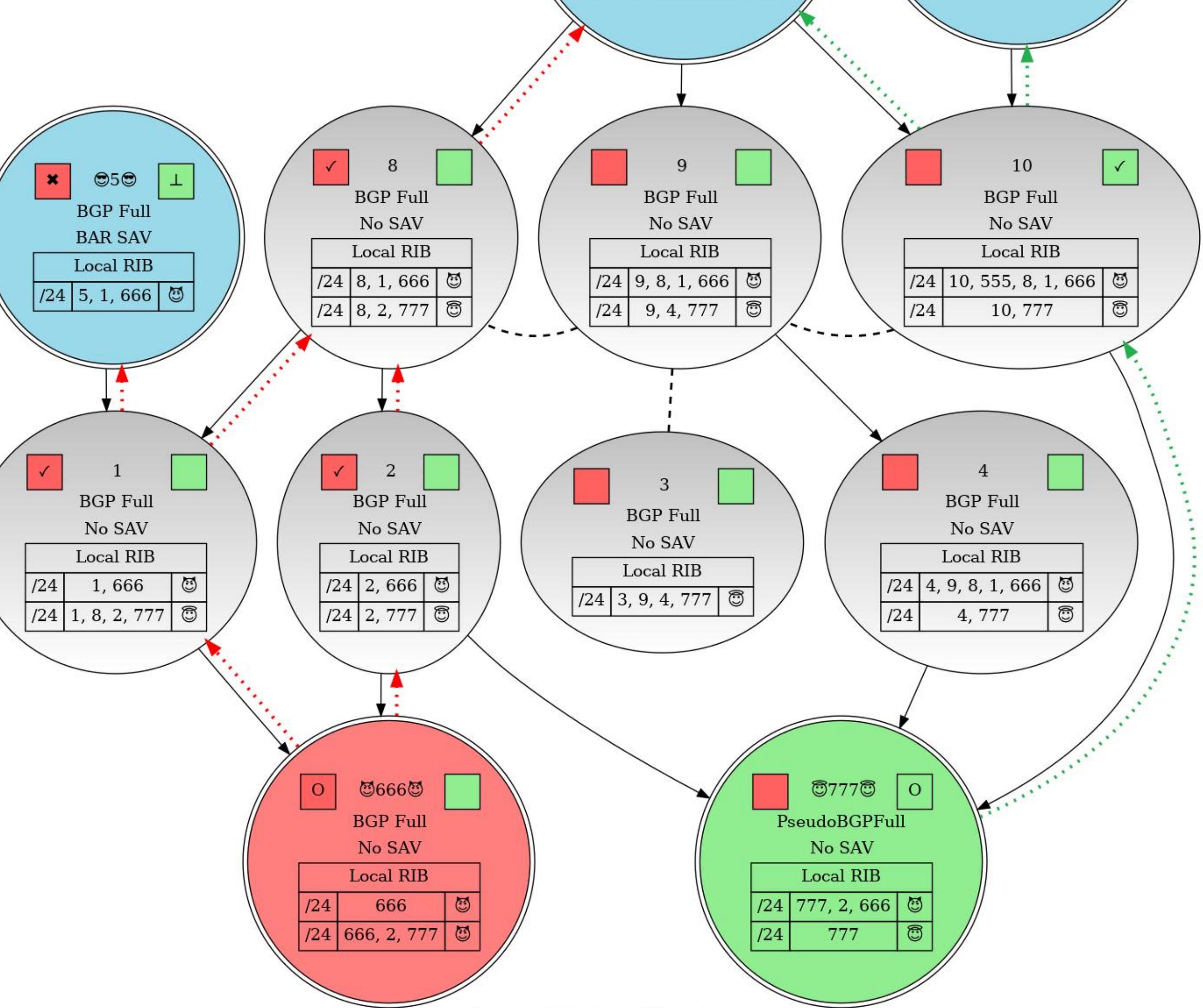


### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	1	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)



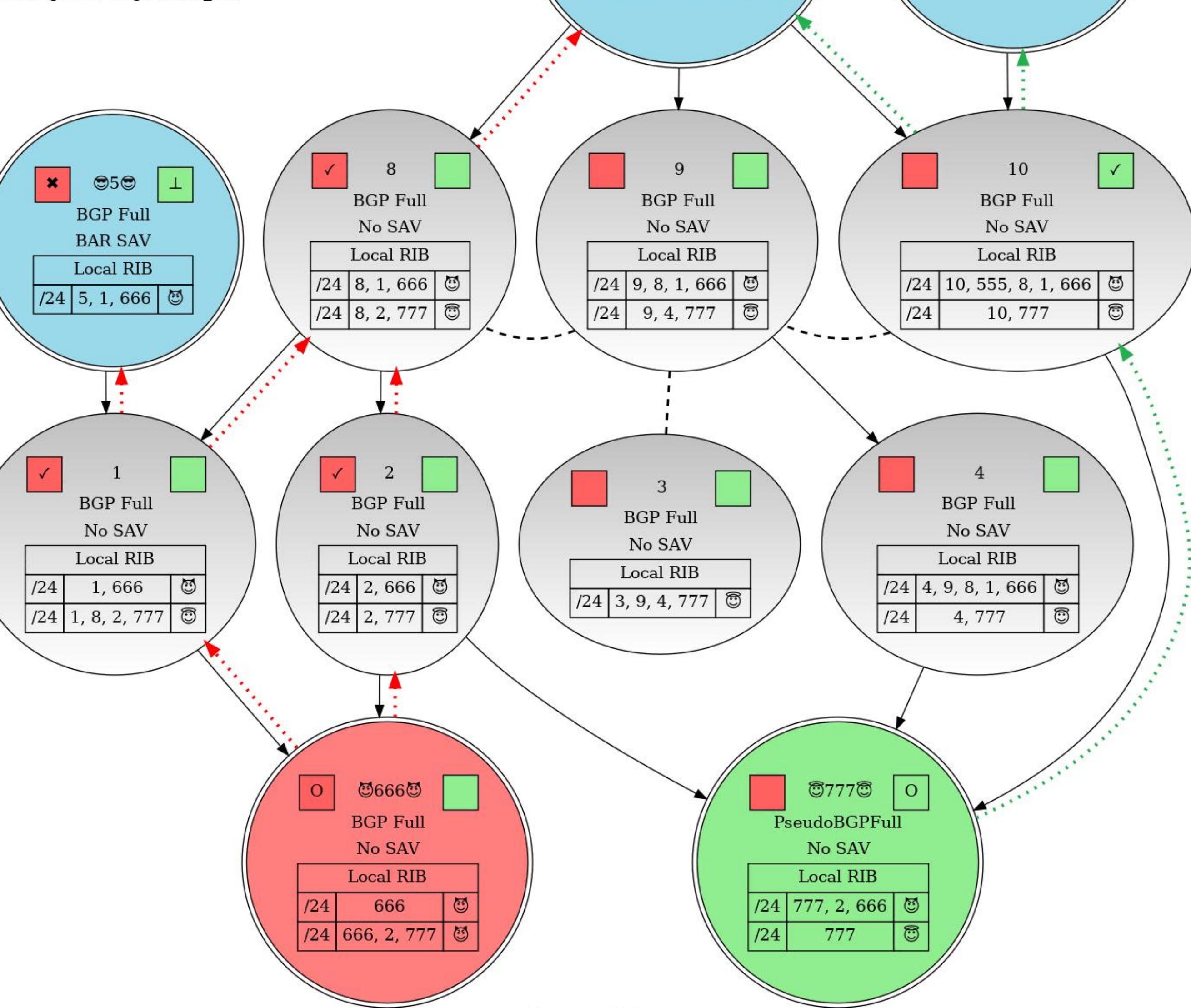
(bar\_sav\_000 Ground Truth)  
Three reflectors running BAR SAV, one disconnected from both victim and attacker

### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	1	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)



(bar\_sav\_000)

Three reflectors running BAR SAV, one disconnected from both victim and attacker

### (Data Plane Outcomes)

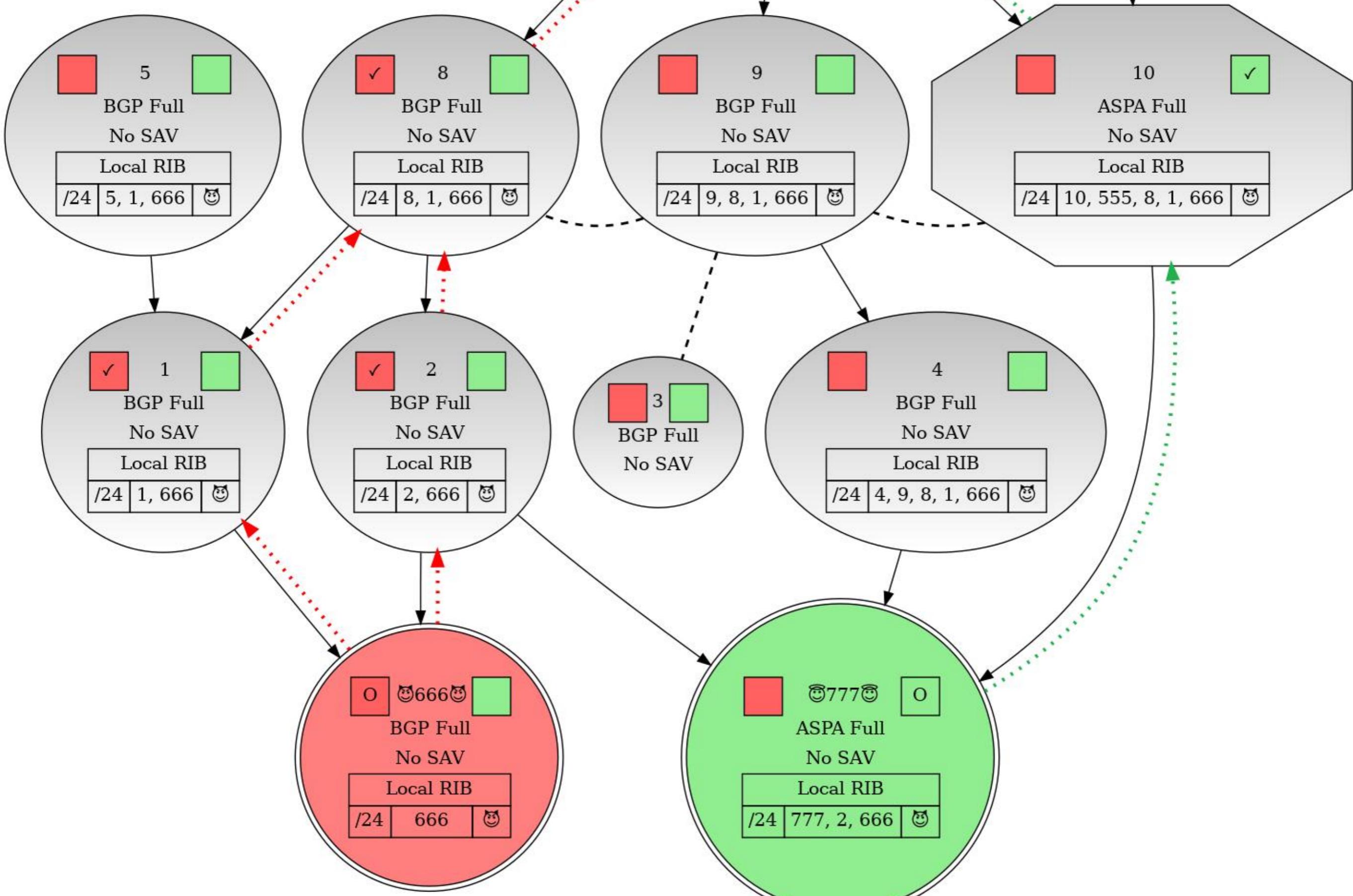
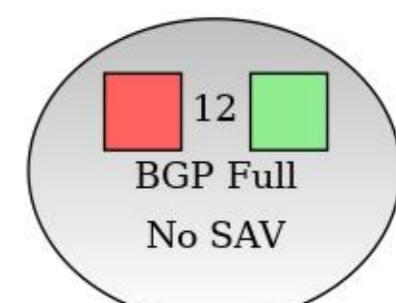
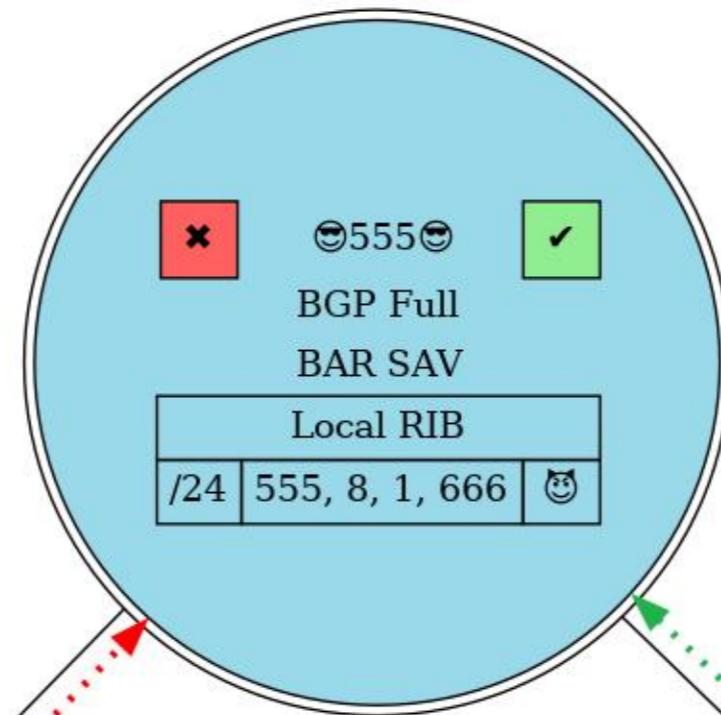
(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	1
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)

7.7.7.0/24 | 777 | 24

(Victim Outcomes)



(bar\_sav\_001 Ground Truth)  
Single reflector running BAR SAV, victim does not announce prefix

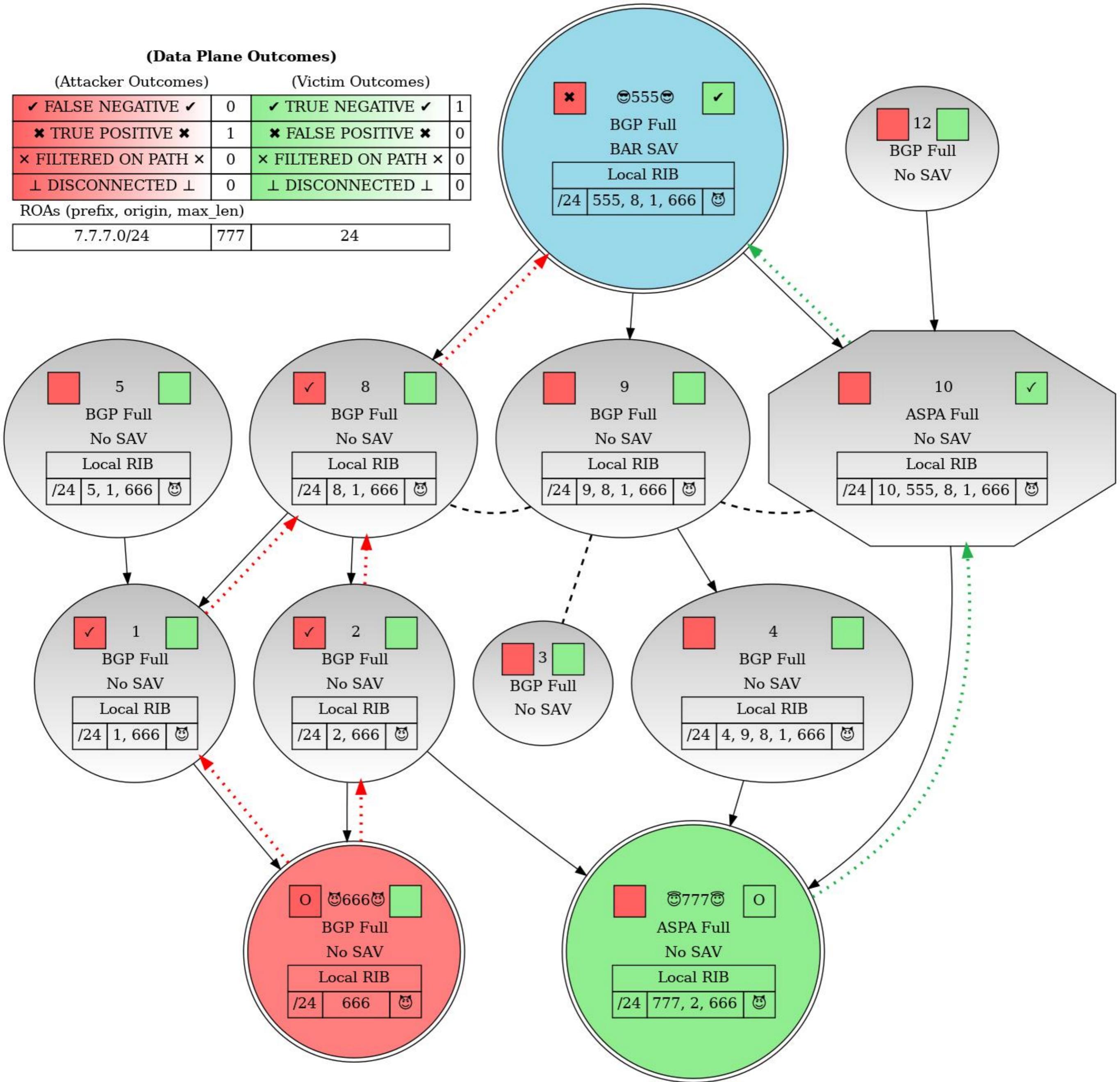
### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	1
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)

7.7.7.0/24	777	24
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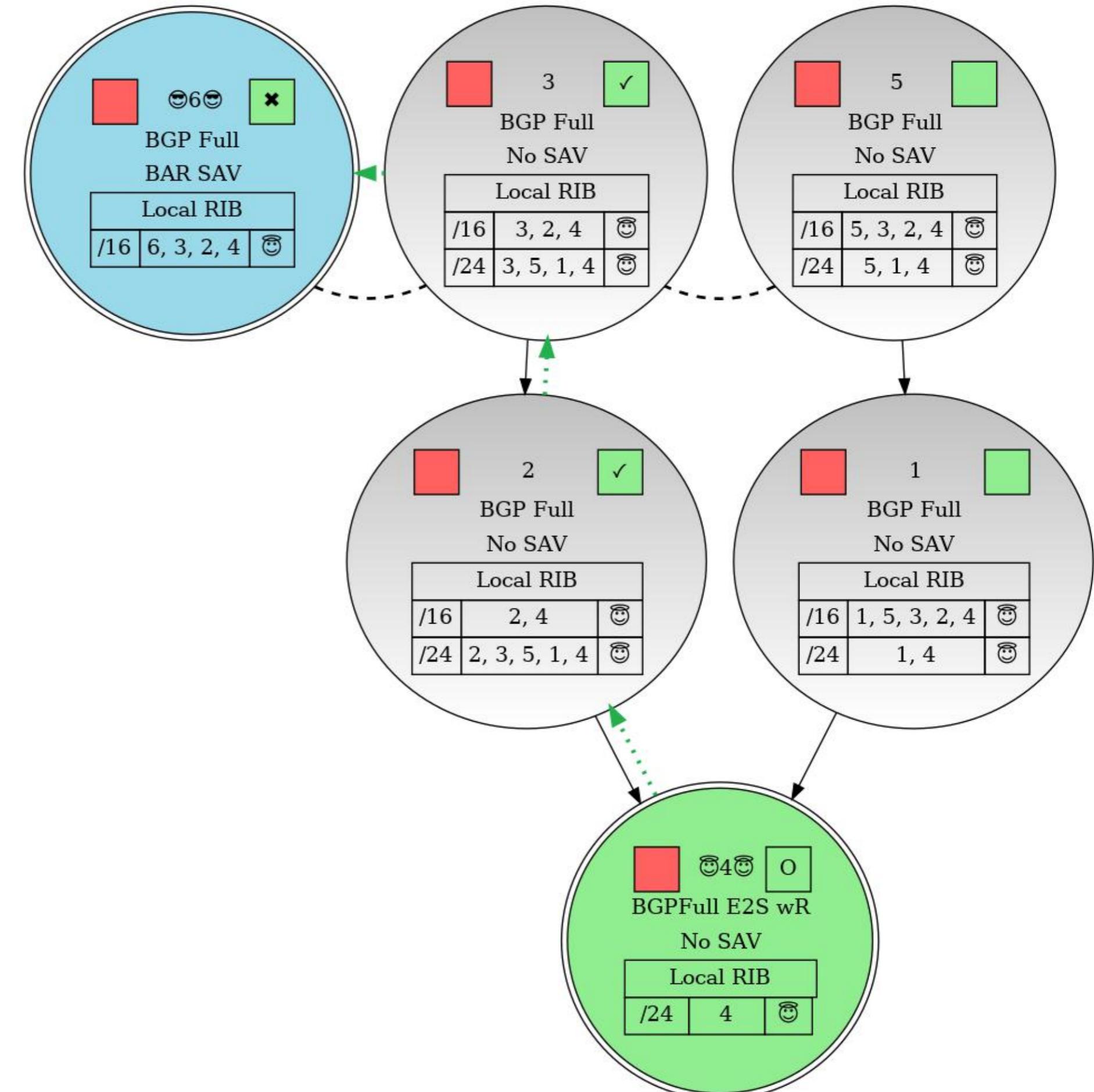
(bar\_sav\_001)  
Single reflector running BAR SAV, victim does not announce prefix

### (Data Plane Outcomes)

(Attacker Outcomes)

	(Victim Outcomes)		
✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	0
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	1
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)



(bar\_sav\_005 Ground Truth)  
BAR SAV False Positive Test No ROA

### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓ 0

✗ TRUE POSITIVE ✗ 0

✗ FILTERED ON PATH ✗ 0

⊥ DISCONNECTED ⊥ 0

(Victim Outcomes)

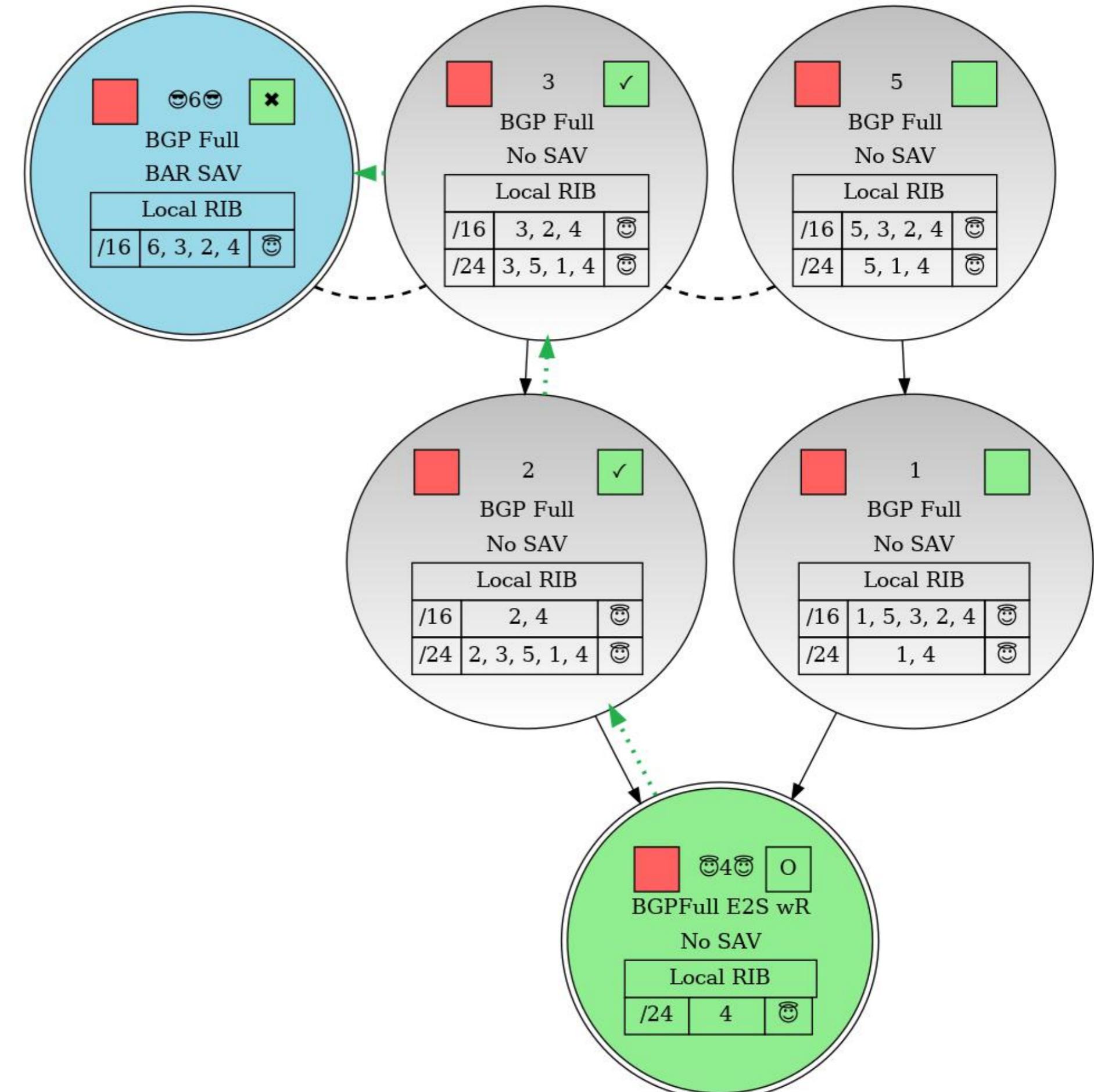
✓ TRUE NEGATIVE ✓ 0

✗ FALSE POSITIVE ✗ 1

✗ FILTERED ON PATH ✗ 0

⊥ DISCONNECTED ⊥ 0

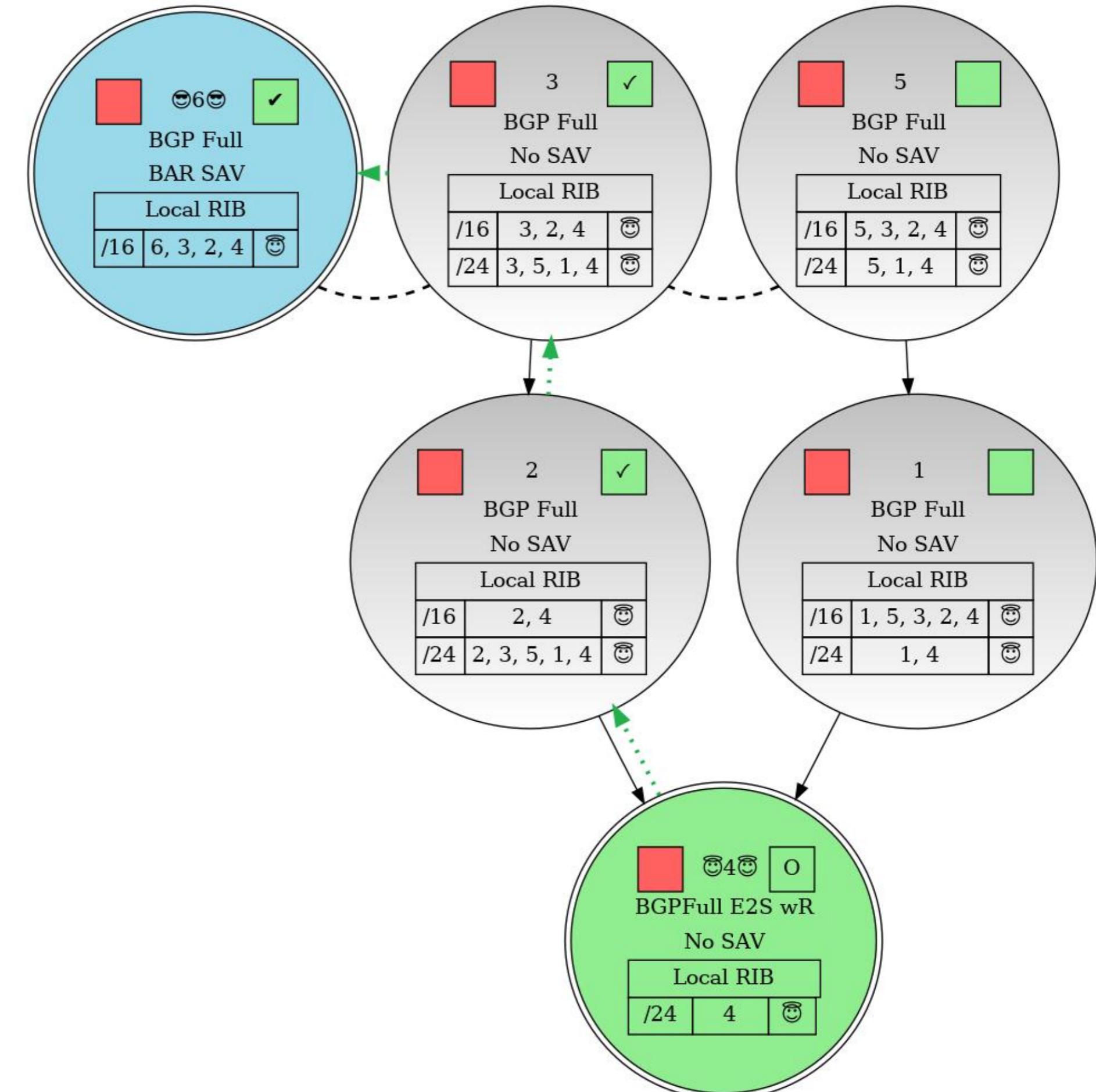
ROAs (prefix, origin, max\_len)



(bar\_sav\_005)  
BAR SAV False Positive Test No ROA

### (Data Plane Outcomes)

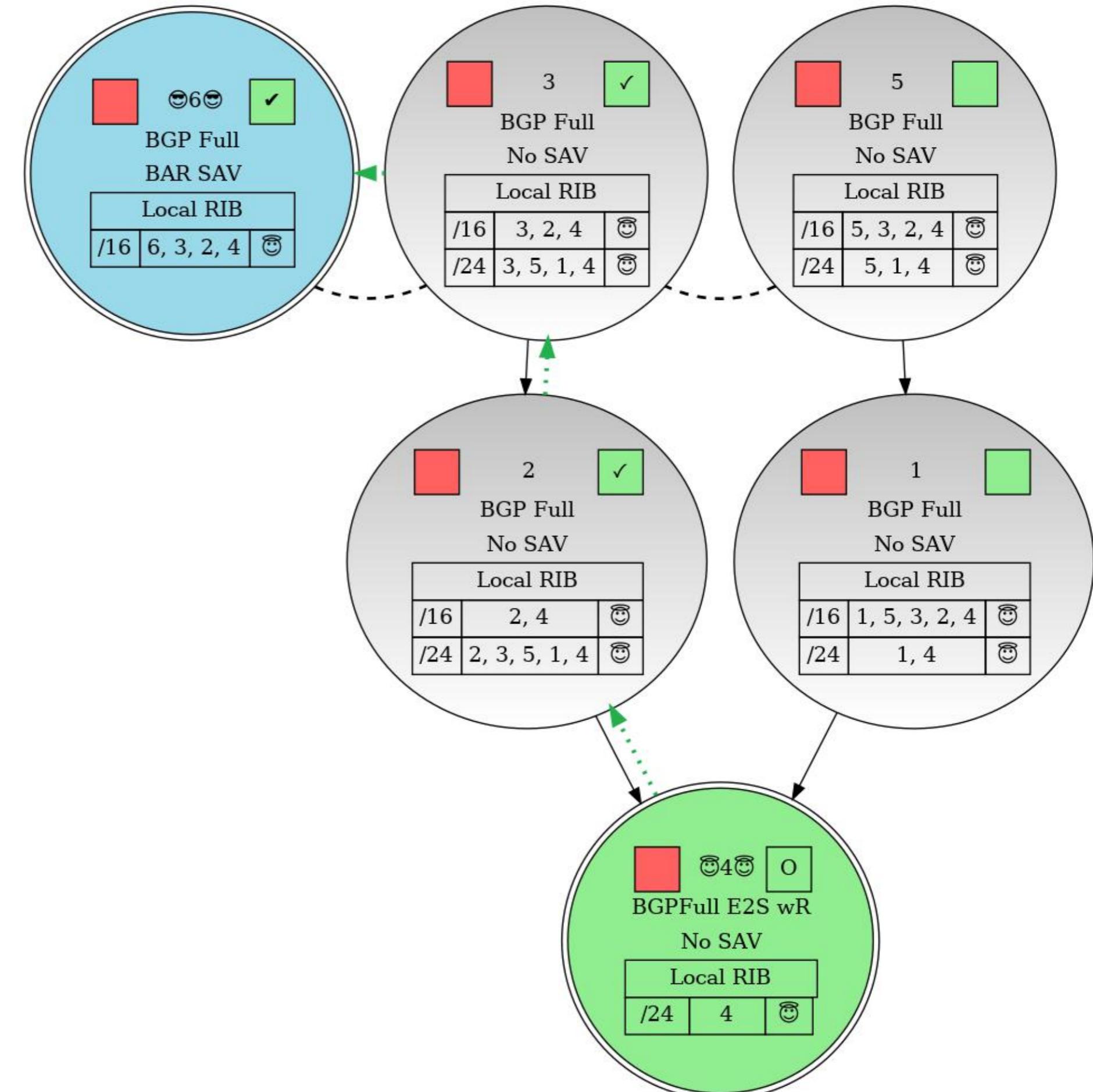
(Attacker Outcomes)		(Victim Outcomes)	
✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	1
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0
ROAs (prefix, origin, max_len)			
7.7.7.0/24	4	24	



(bar\_sav\_006 Ground Truth)  
BAR SAV False Positive Test with ROA (Expecting True Negative)

### (Data Plane Outcomes)

(Attacker Outcomes)		(Victim Outcomes)	
✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	1
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0
ROAs (prefix, origin, max_len)			
7.7.7.0/24	4	24	



(bar\_sav\_006)

BAR SAV False Positive Test with ROA (Expecting True Negative)

## (Data Plane Outcomes)

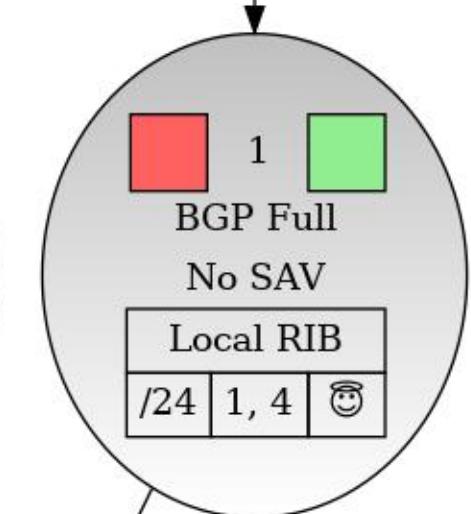
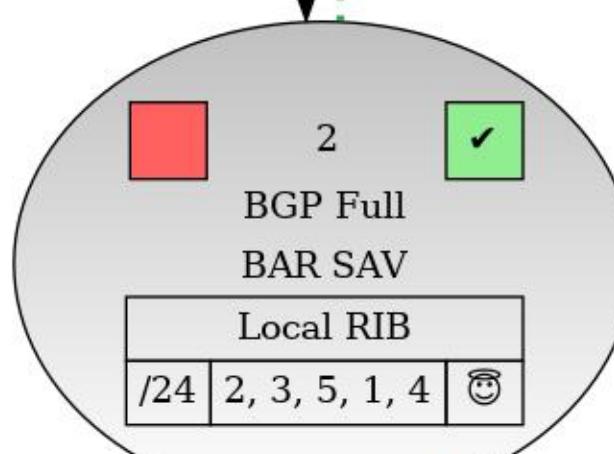
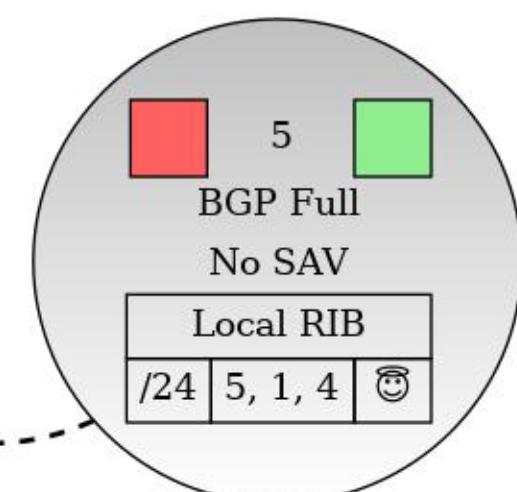
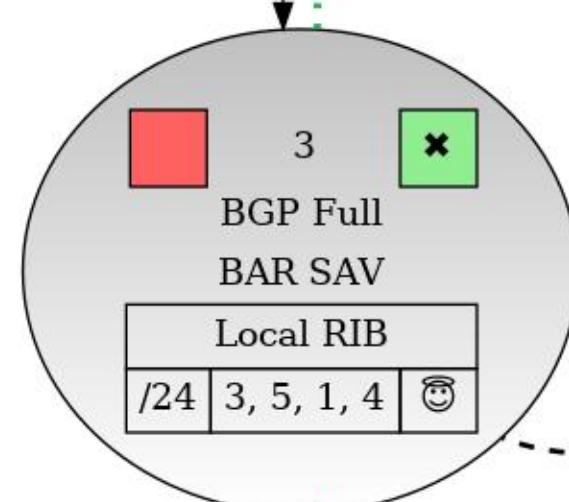
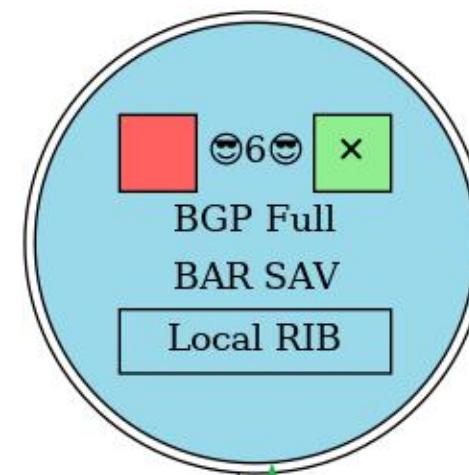
(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	1
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	1
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	1
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

(Victim Outcomes)

ROAs (prefix, origin, max\_len)

7.7.7.0/24	4	24
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(bar\_sav\_007 Ground Truth)  
BAR SAV False Positive Test with ROA

## (Data Plane Outcomes)

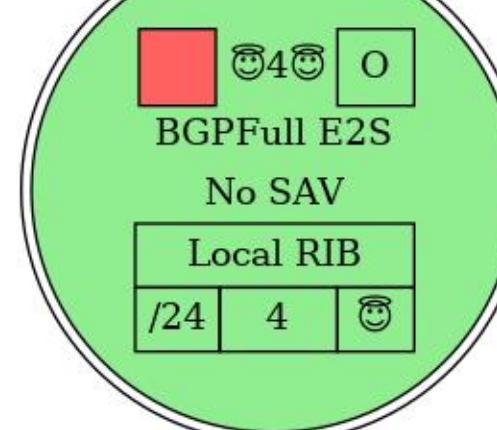
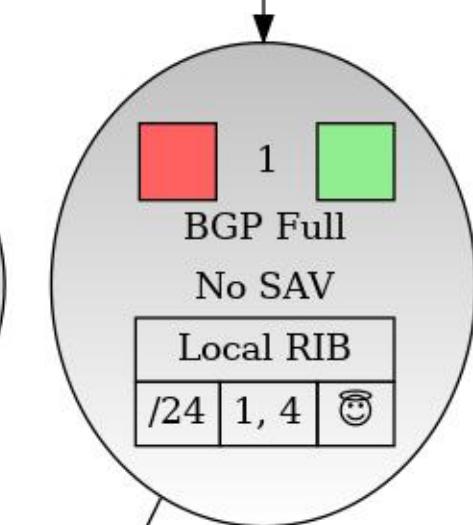
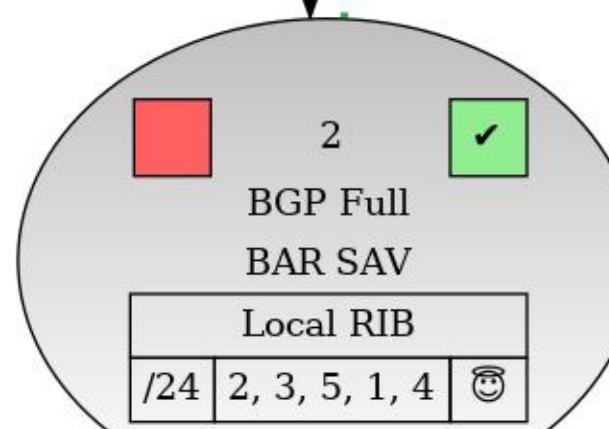
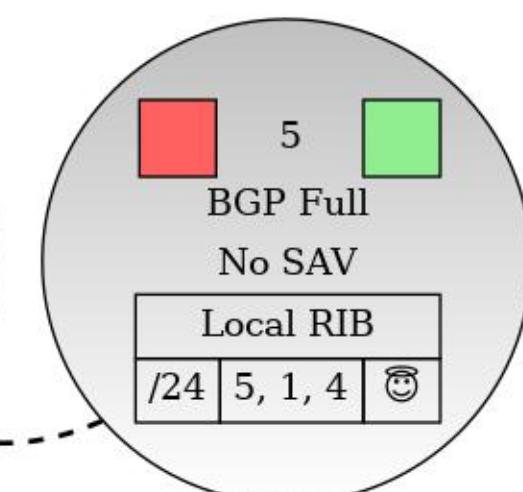
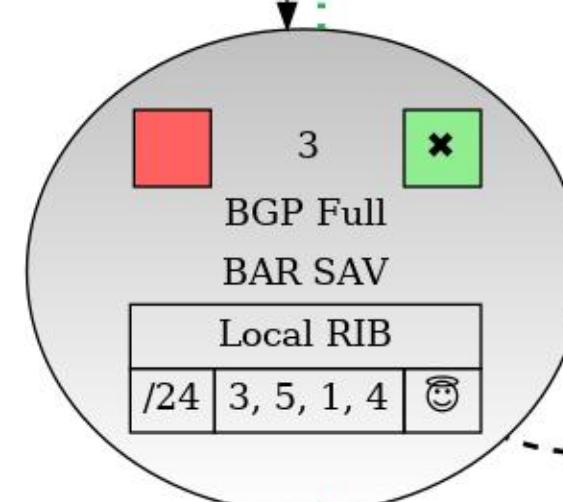
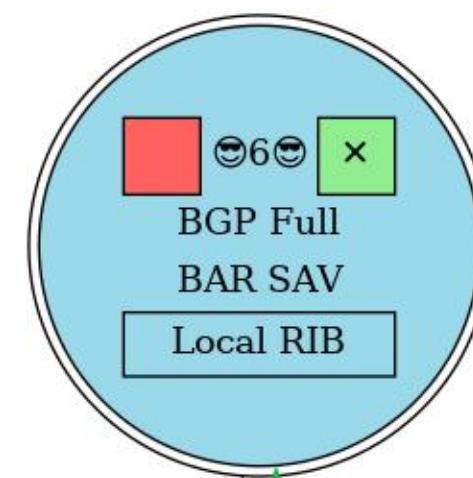
(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	1
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	1
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	1
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

(Victim Outcomes)

ROAs (prefix, origin, max\_len)

7.7.7.0/24	4	24
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(bar\_sav\_007)  
BAR SAV False Positive Test with ROA

## (Data Plane Outcomes)

(Attacker Outcomes)

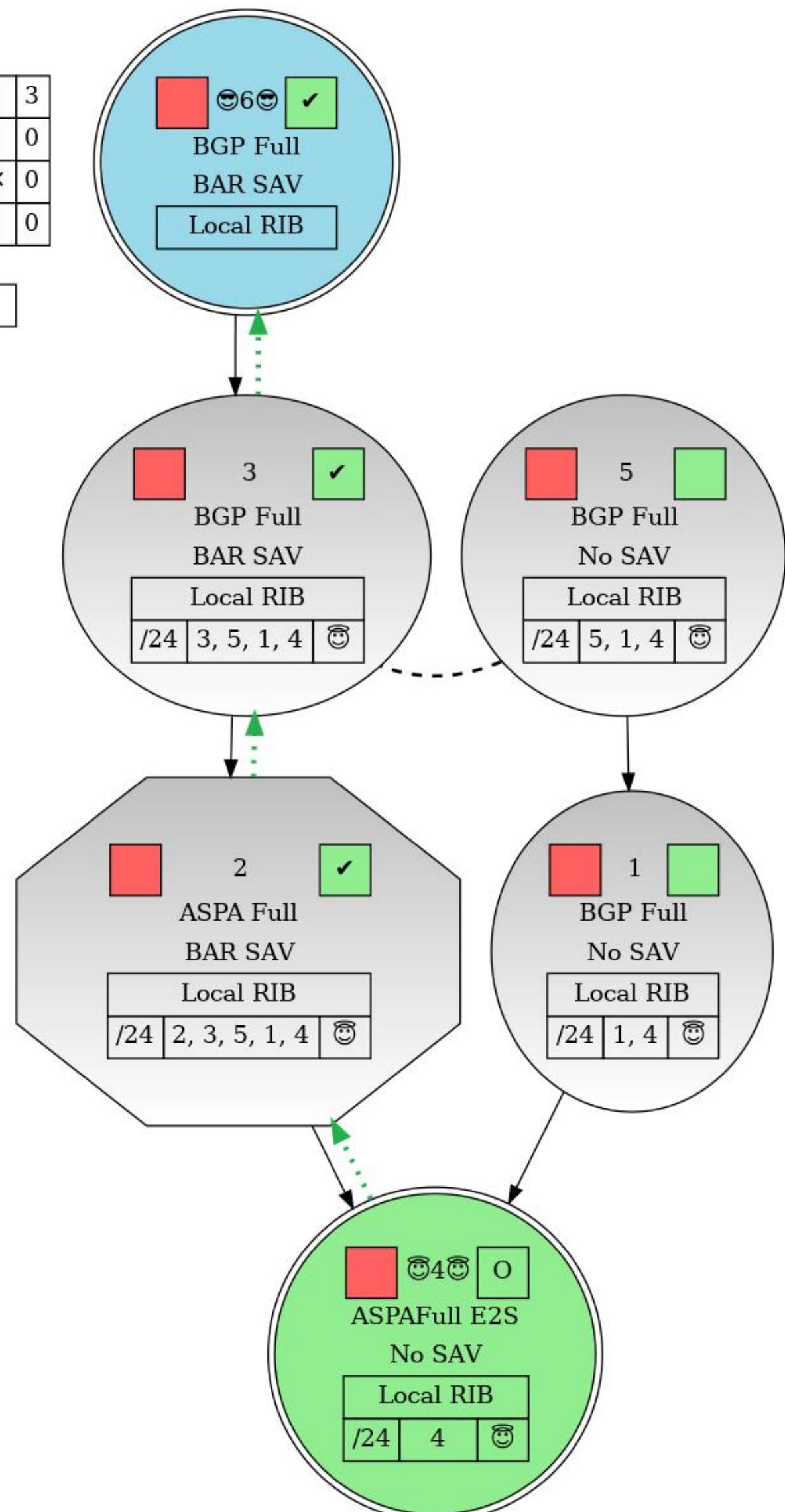
✓ FALSE NEGATIVE ✓	0
✗ TRUE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0

(Victim Outcomes)

✓ TRUE NEGATIVE ✓	3
✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)

7.7.7.0/24	4	24
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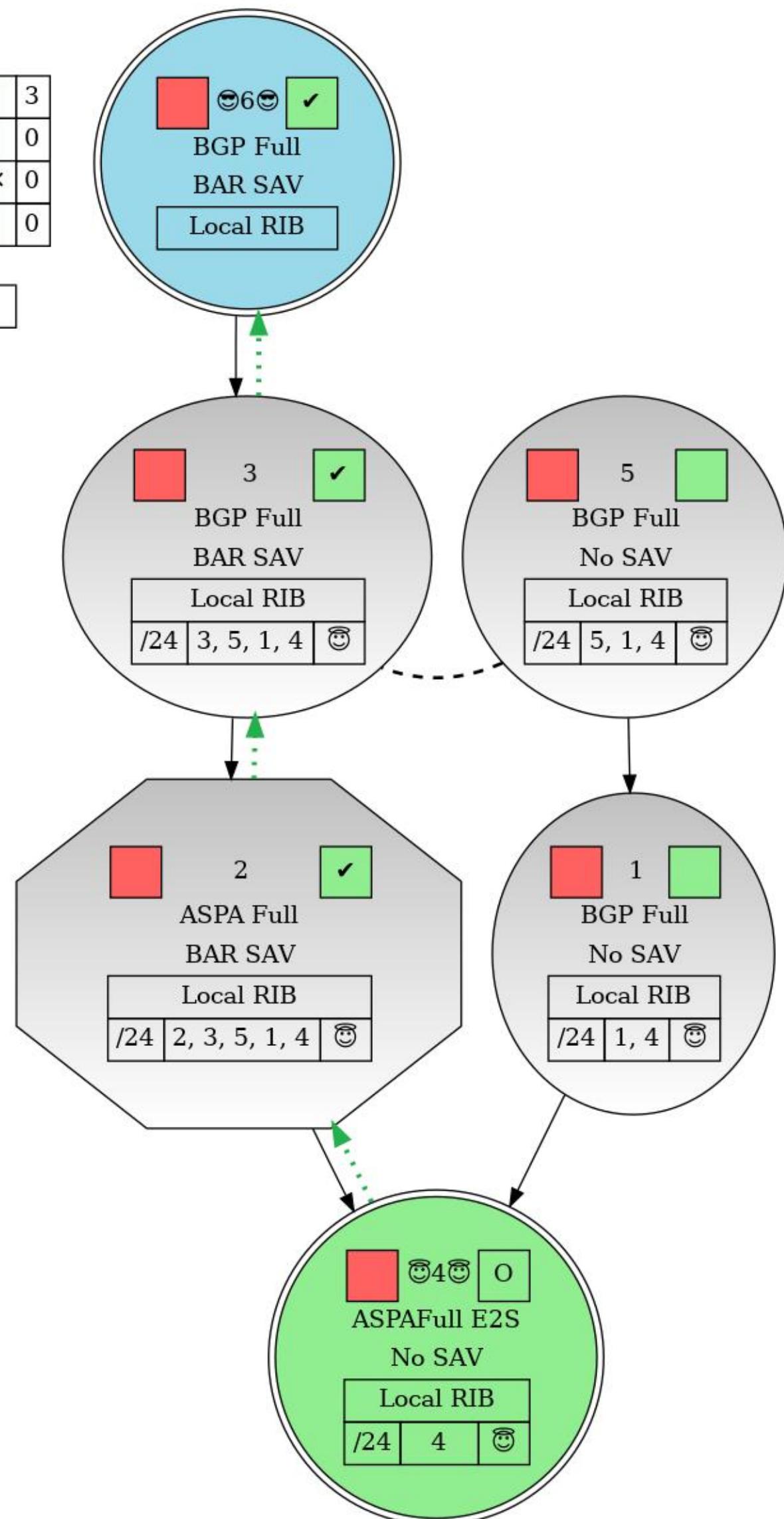
(bar\_sav\_008 Ground Truth)  
BAR SAV False Positive Test with ROA and ASPA (Expecting True Negative)

## (Data Plane Outcomes)

(Attacker Outcomes)		(Victim Outcomes)	
✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	3
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)

7.7.7.0/24	4	24
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(bar\_sav\_008)  
BAR SAV False Positive Test with ROA and ASPA (Expecting True Negative)

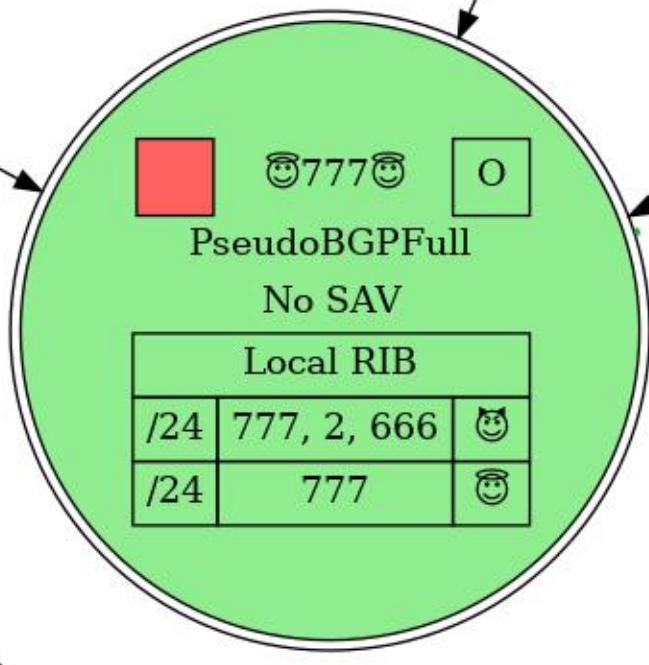
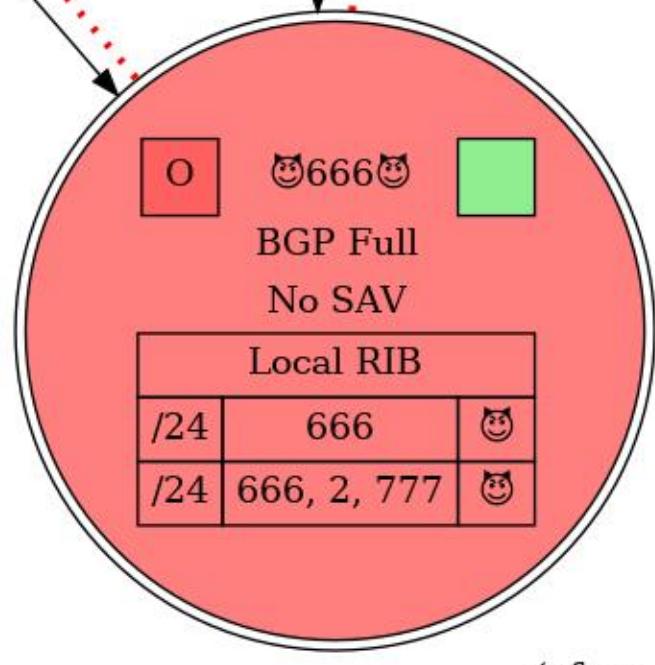
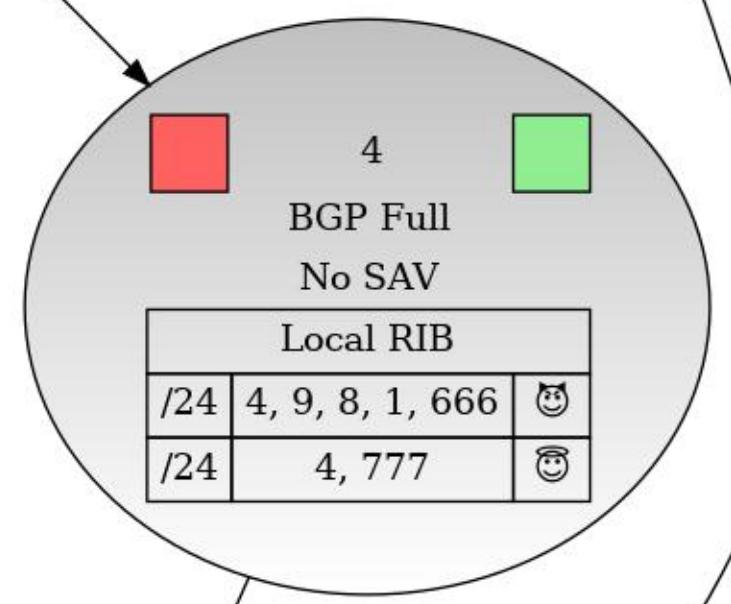
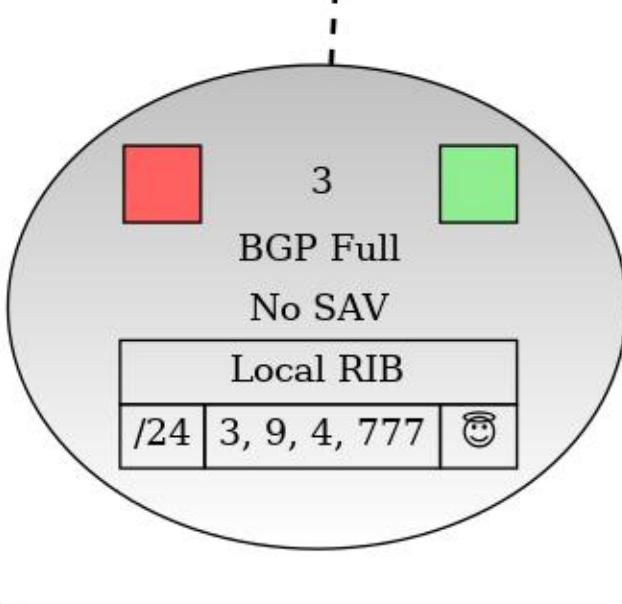
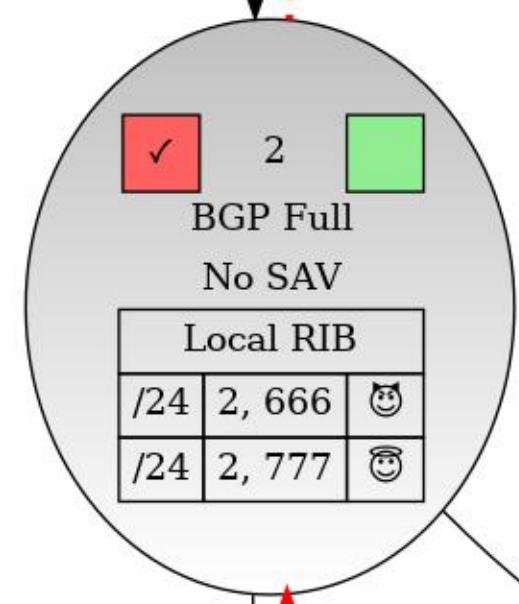
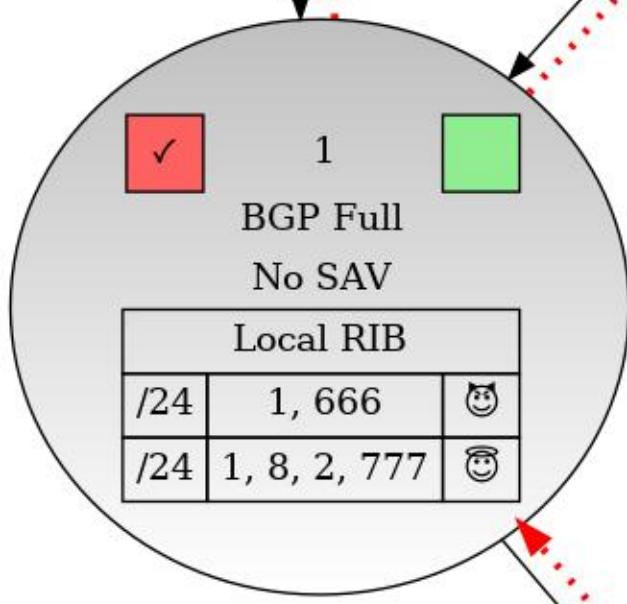
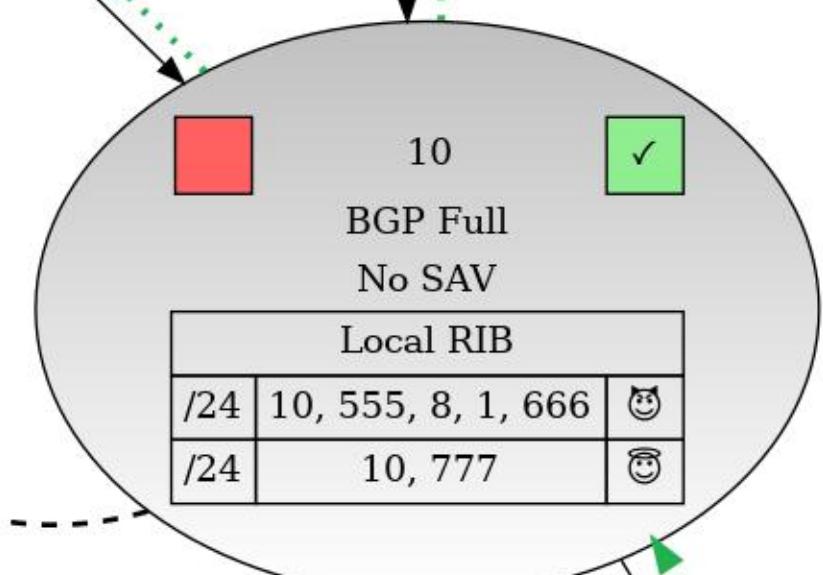
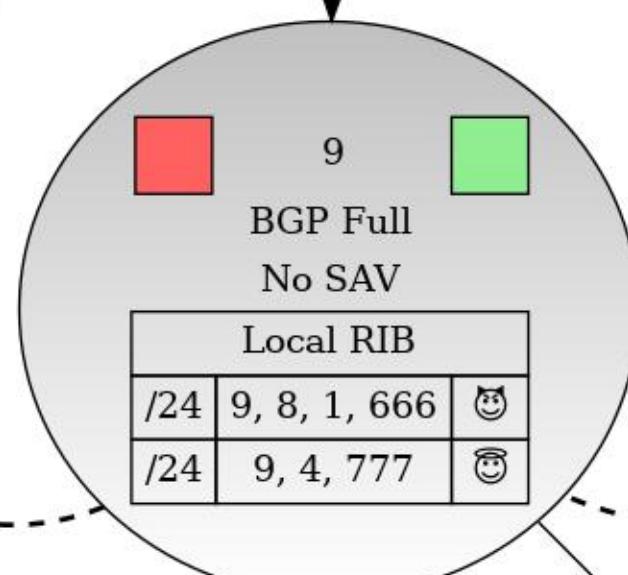
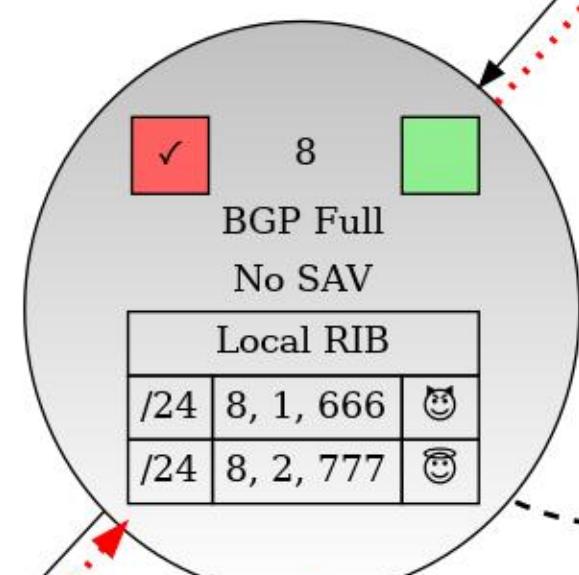
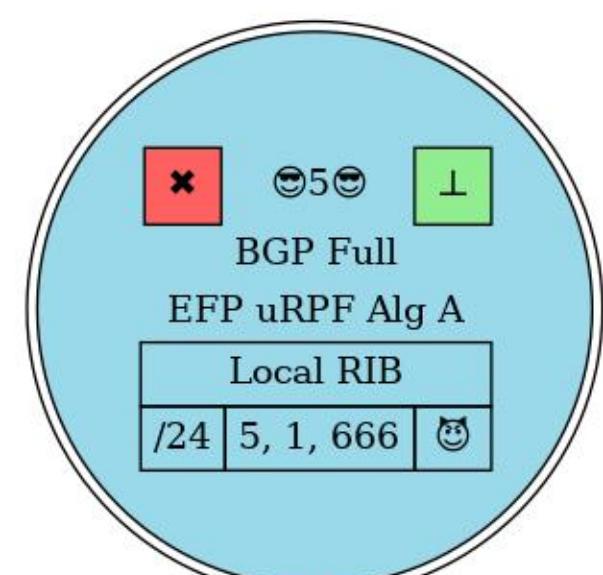
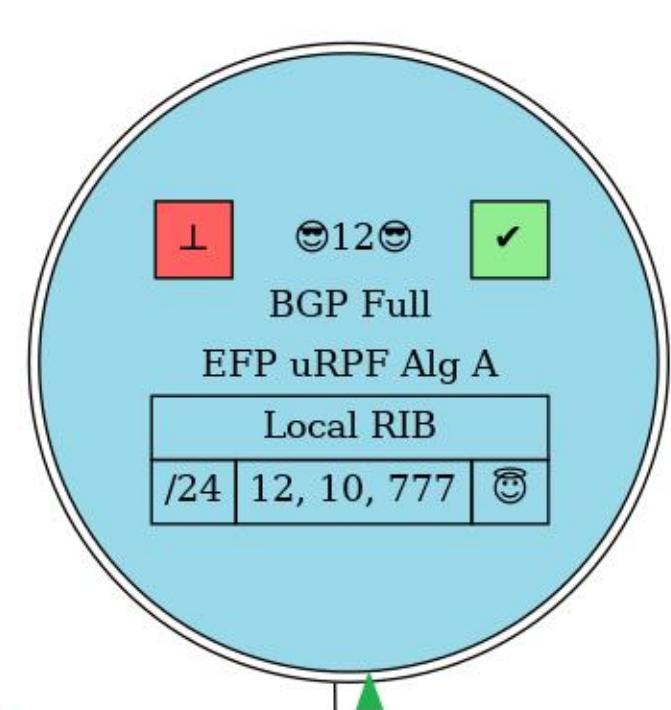
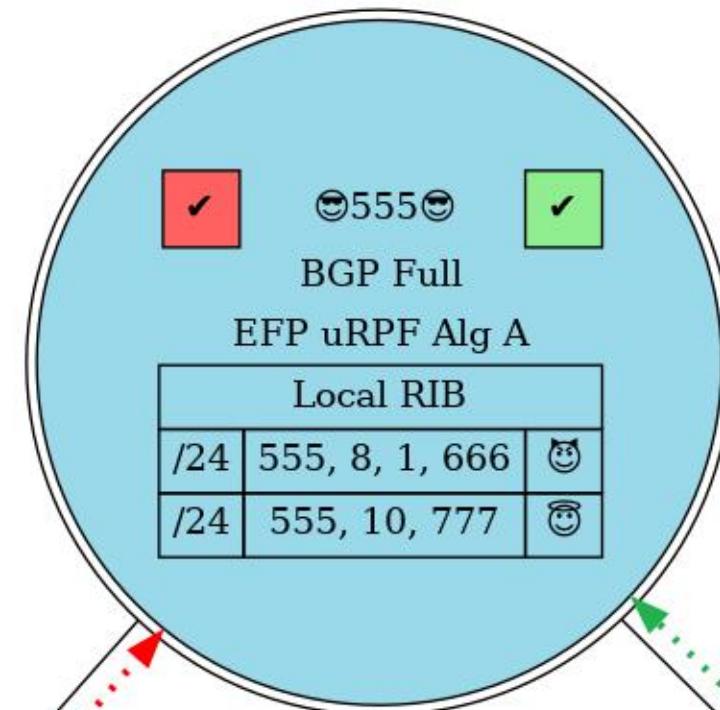
### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	1	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)

(Victim Outcomes)



(efp\_a\_000 Ground Truth)

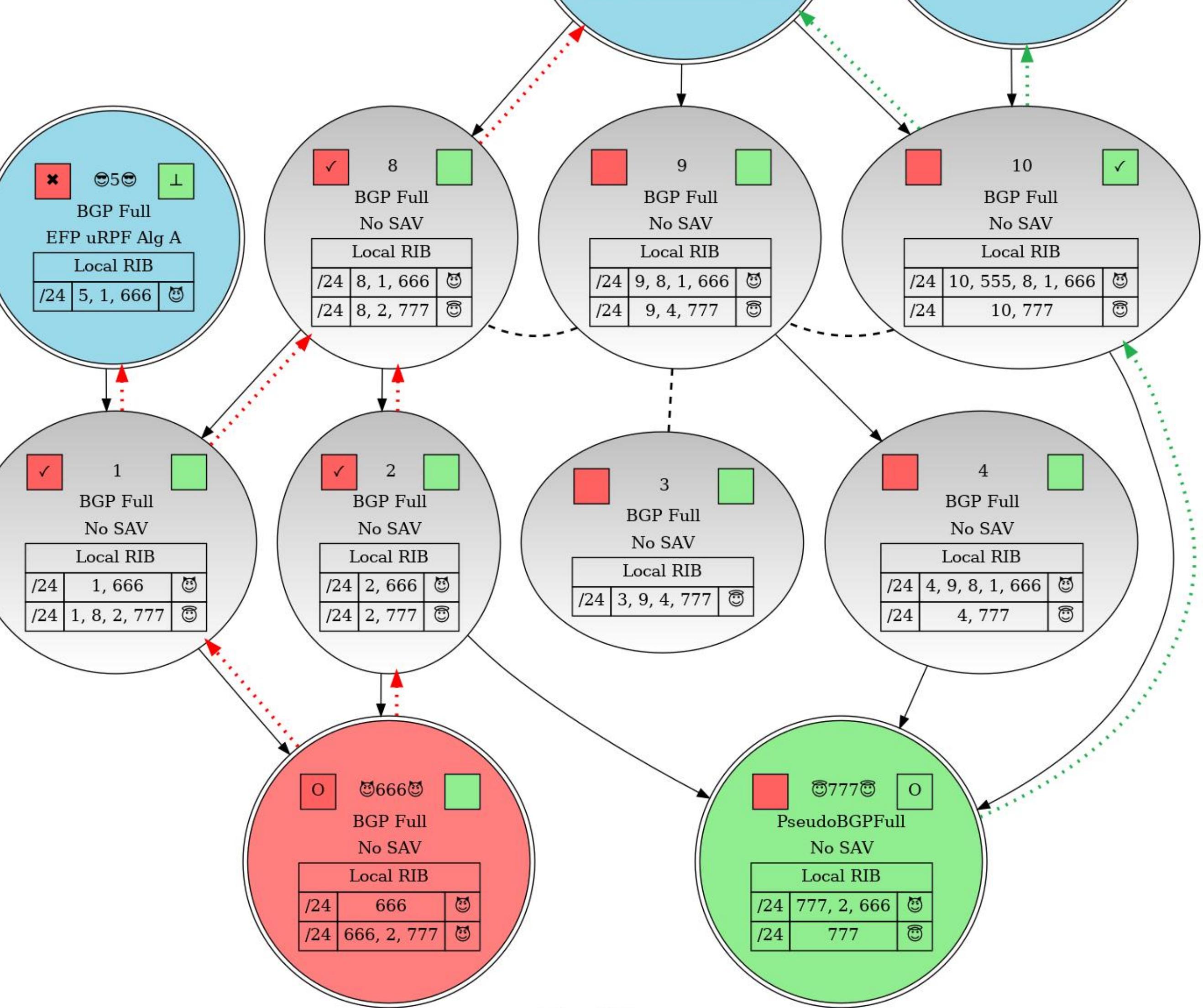
Three reflectors running EFP uRPF Alg A, one disconnected from both victim and attacker

### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	1	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)



(efp\_a\_000)

Three reflectors running EFP uRPF Alg A, one disconnected from both victim and attacker

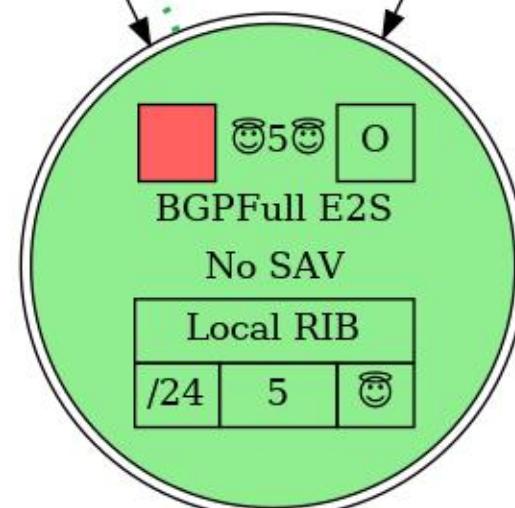
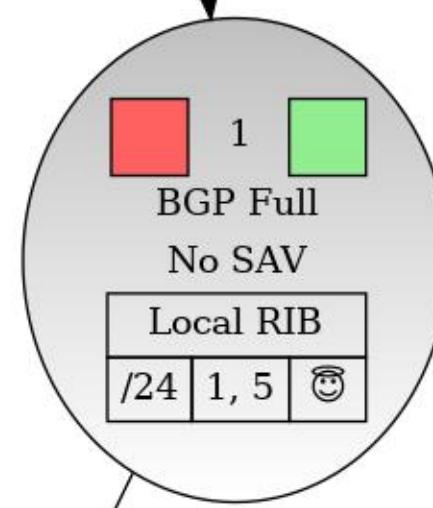
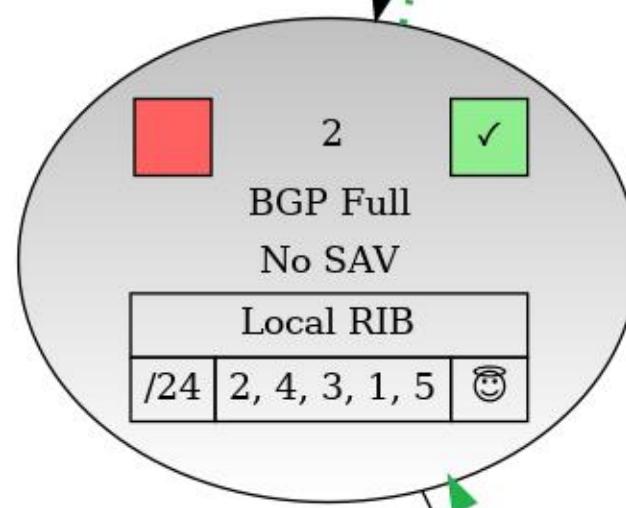
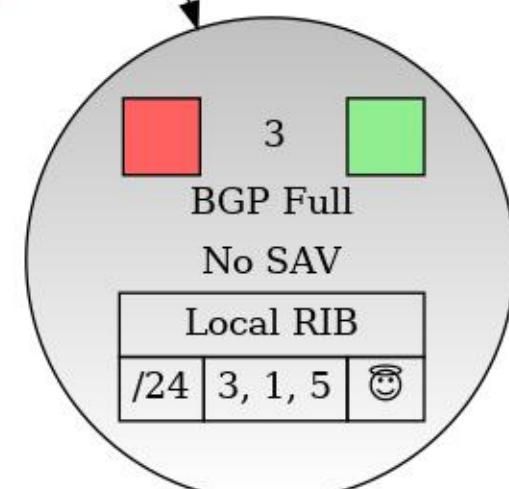
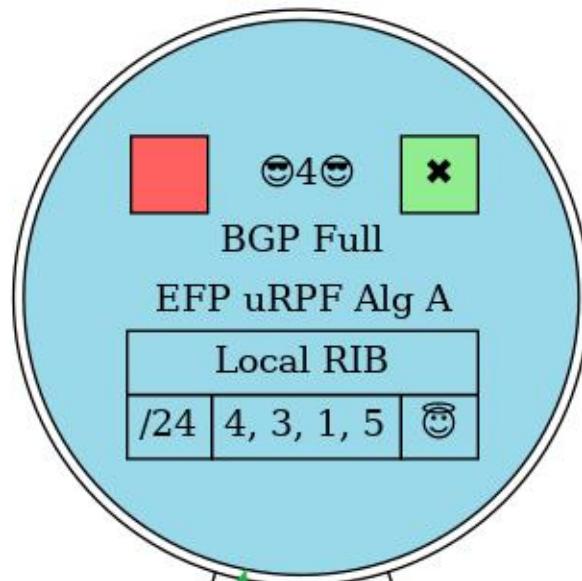
## (Data Plane Outcomes)

(Attacker Outcomes)

(Victim Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	0
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	1
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)



(efp\_a\_001 Ground Truth)  
Export 2 some failing for EFP Alg A

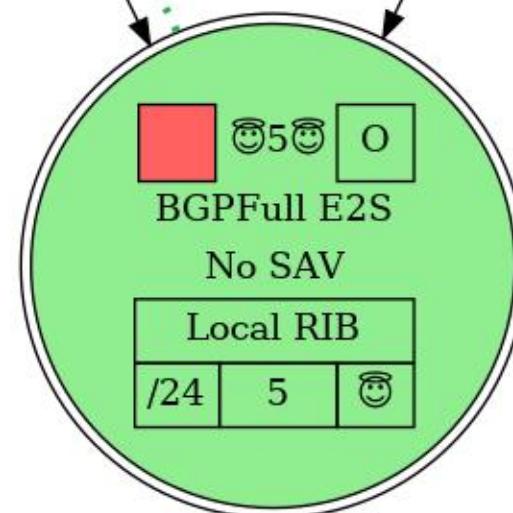
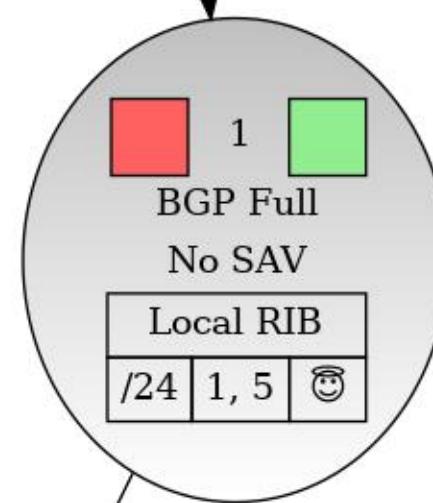
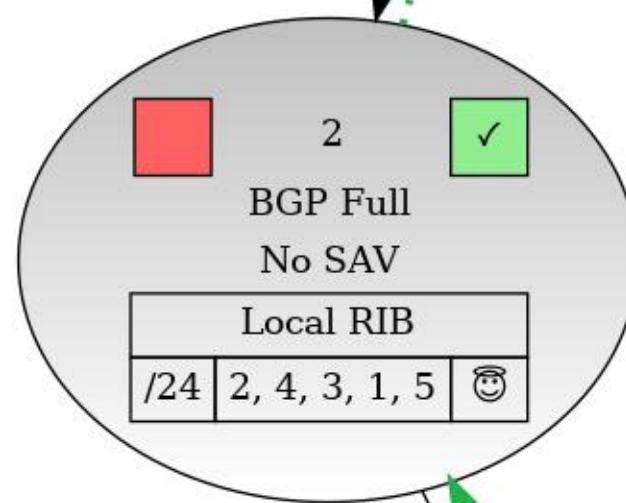
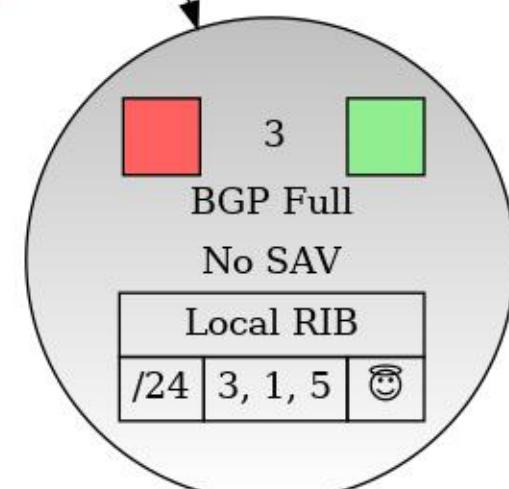
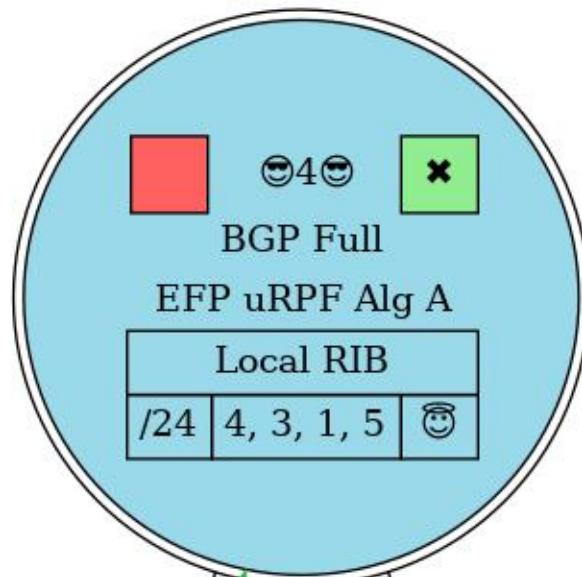
## (Data Plane Outcomes)

(Attacker Outcomes)

(Victim Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	0
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	1
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)



(efp\_a\_001)  
Export 2 some failing for EFP Alg A

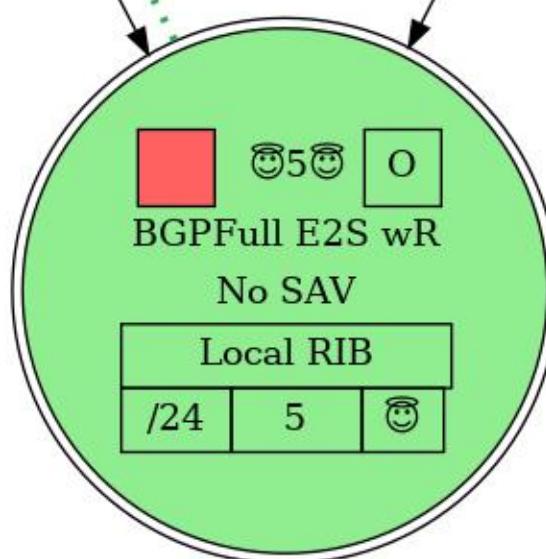
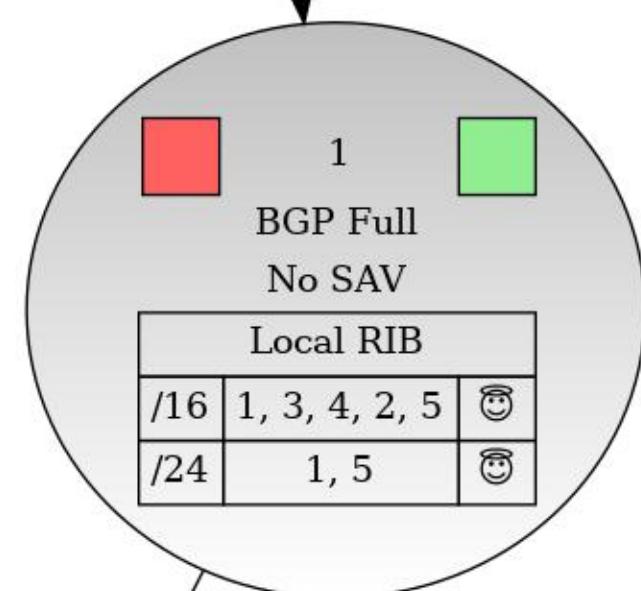
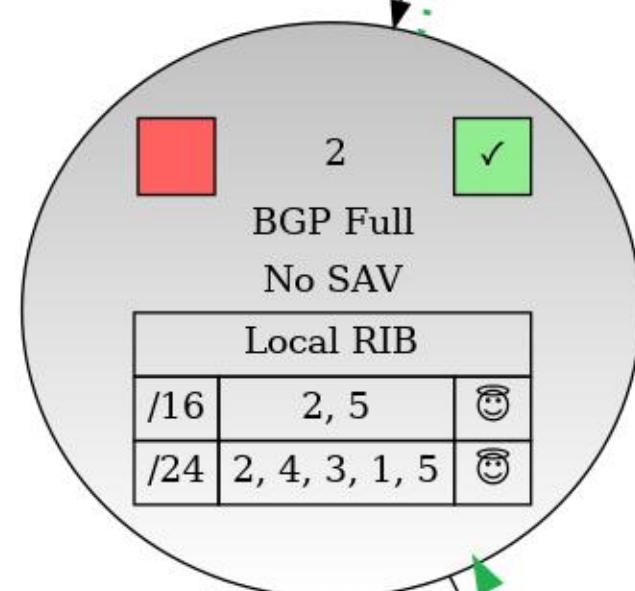
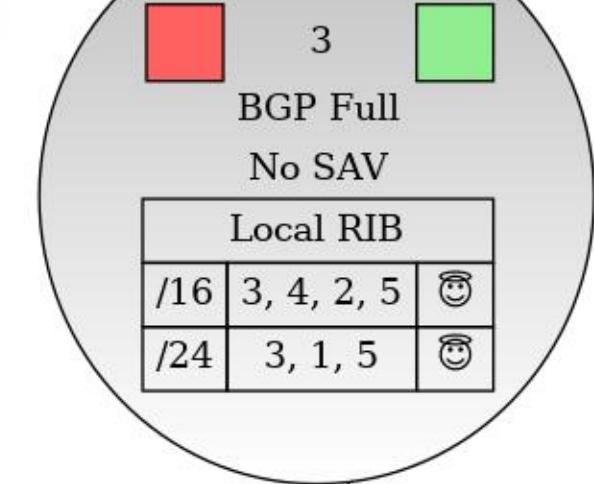
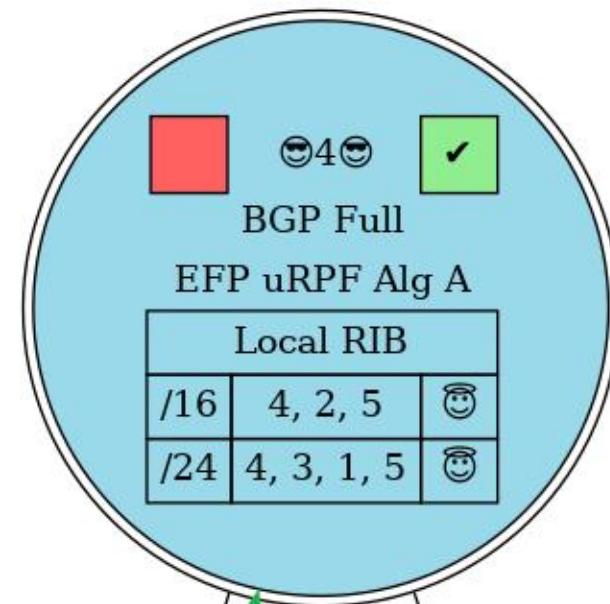
### (Data Plane Outcomes)

(Attacker Outcomes)

(Victim Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	1
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)



(efp\_a\_002 Ground Truth)  
Export 2 some (with replacement) passing for EFP Alg A

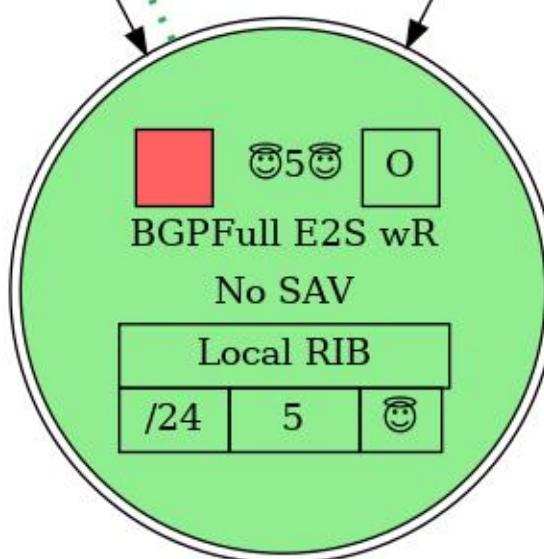
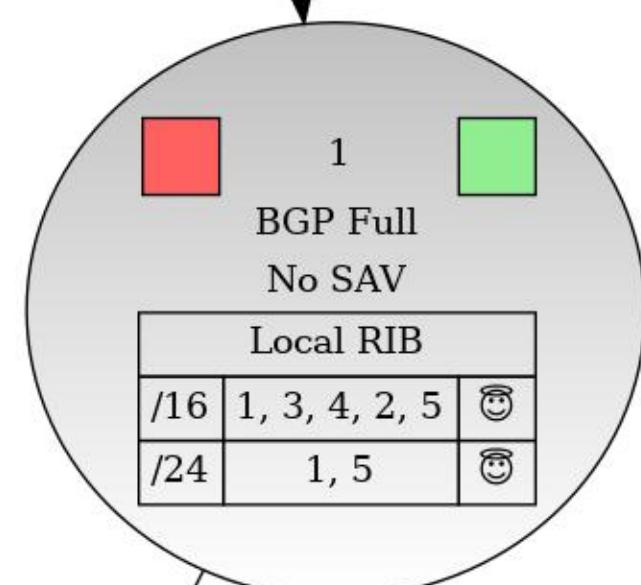
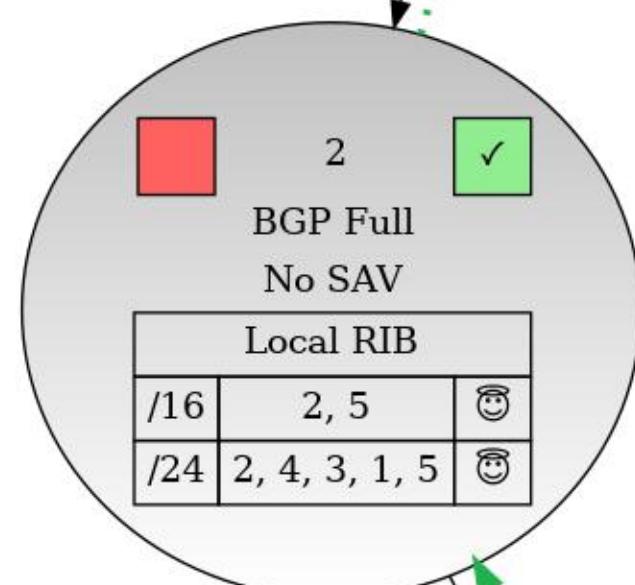
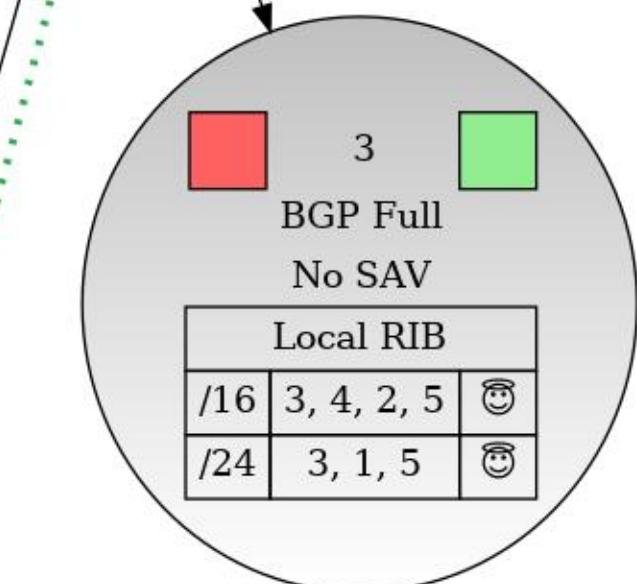
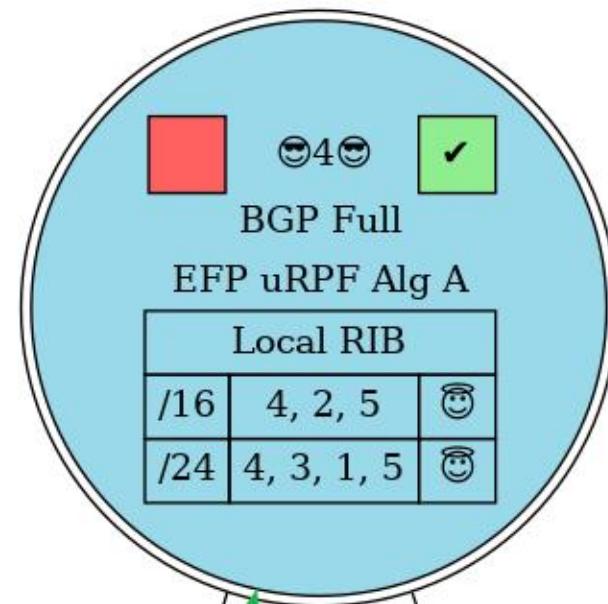
### (Data Plane Outcomes)

(Attacker Outcomes)

(Victim Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	1
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)



(efp\_a\_002)  
Export 2 some (with replacement) passing for EFP Alg A

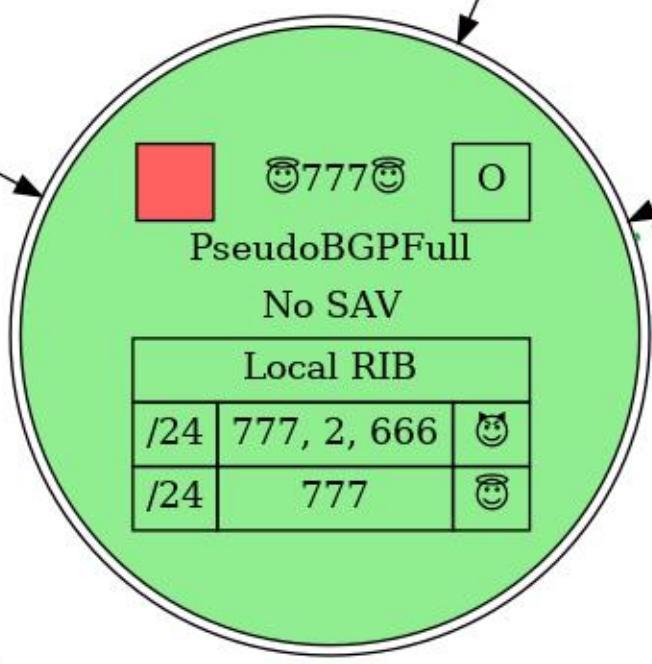
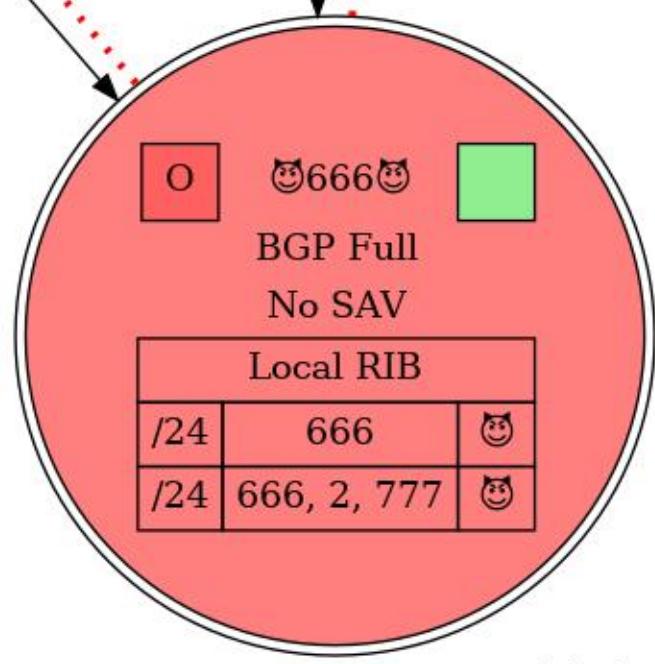
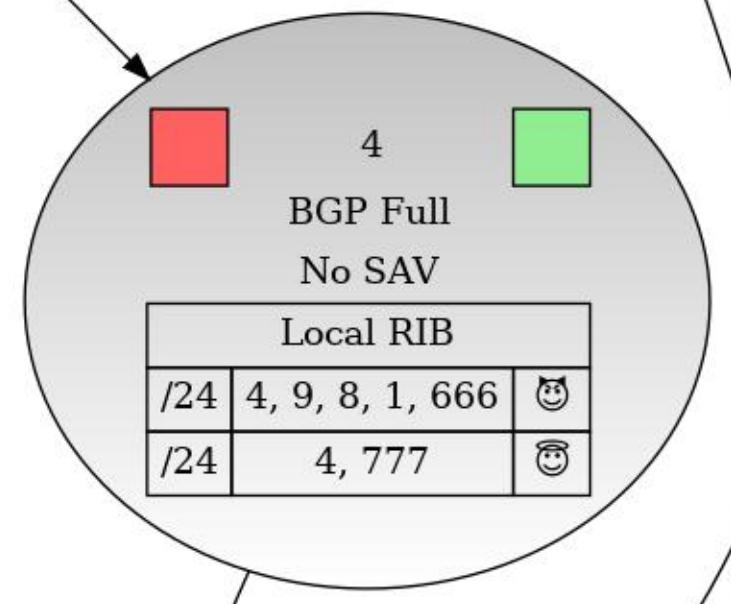
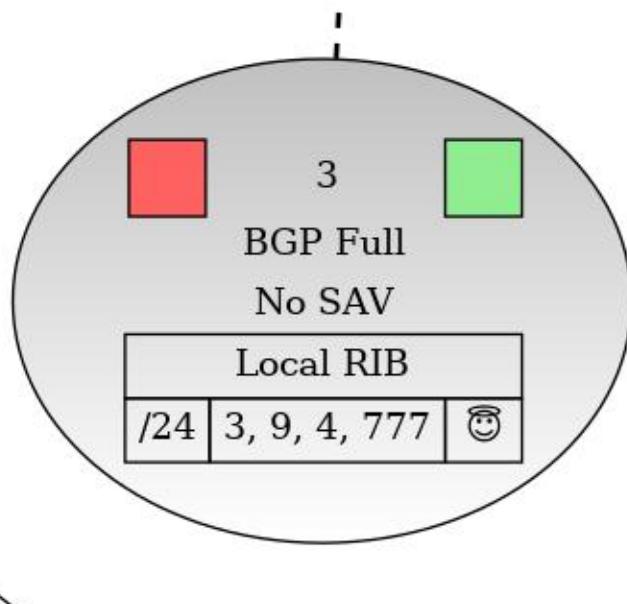
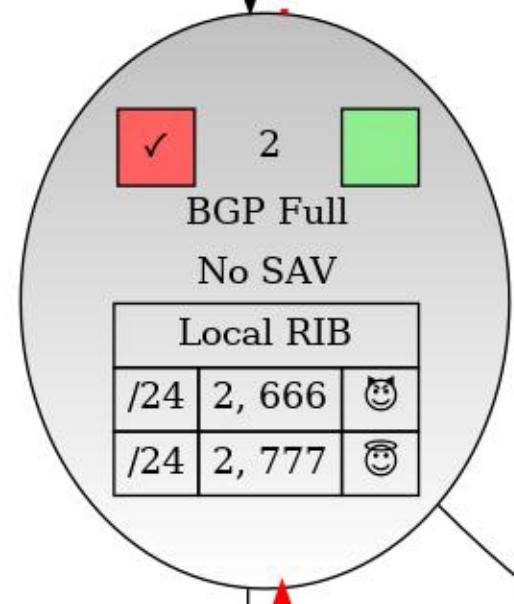
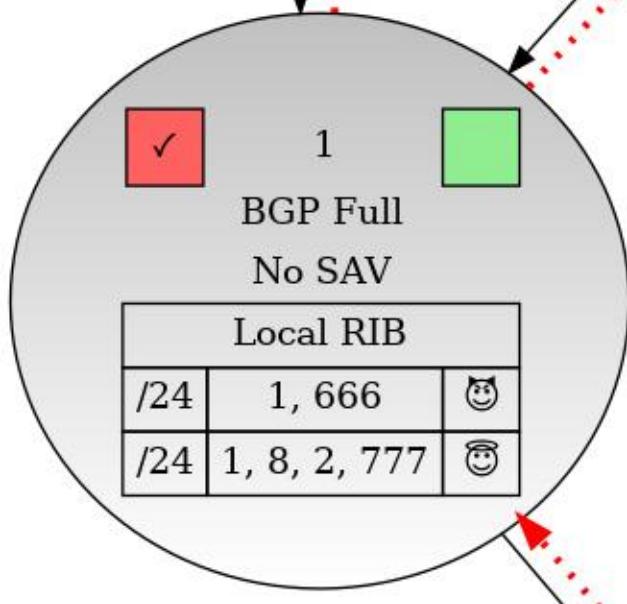
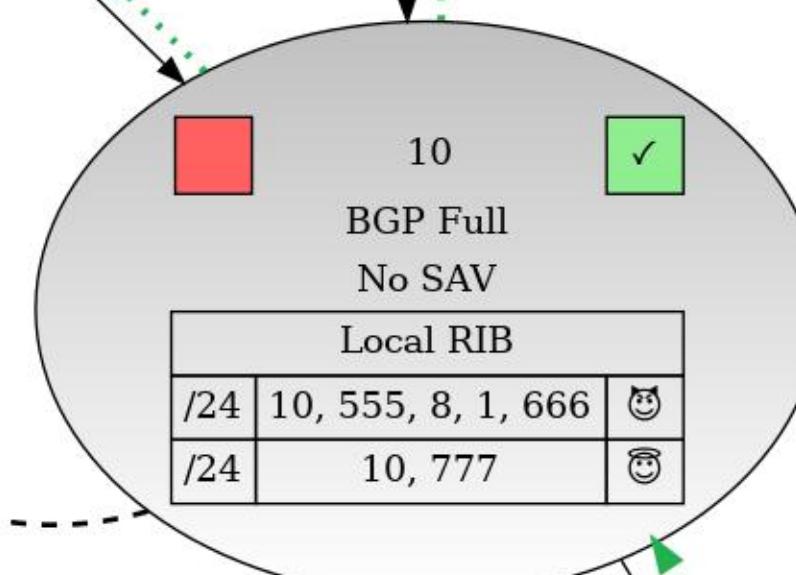
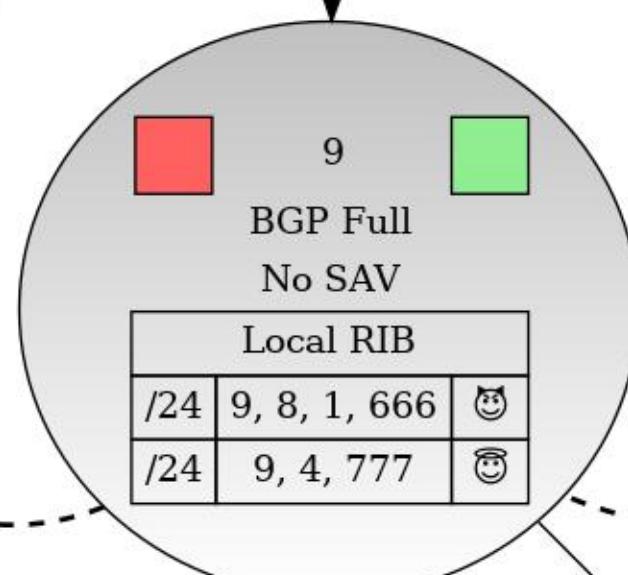
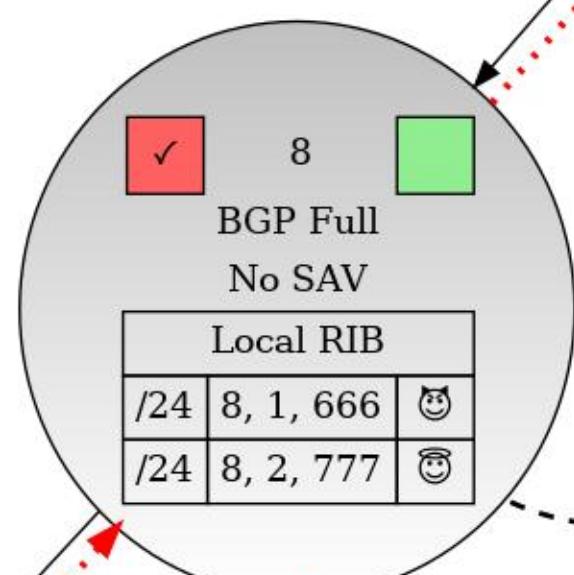
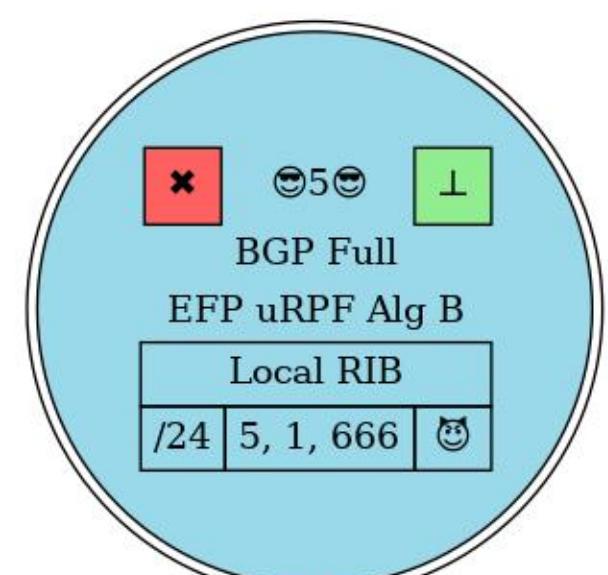
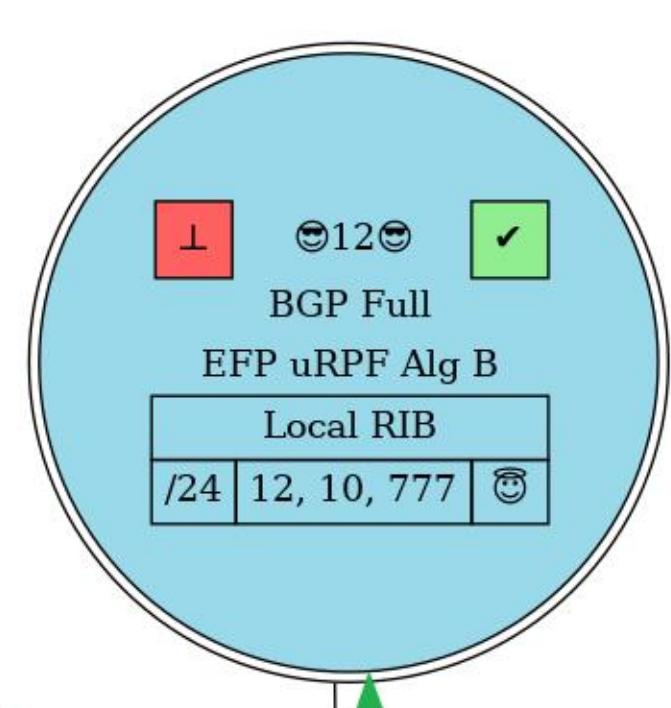
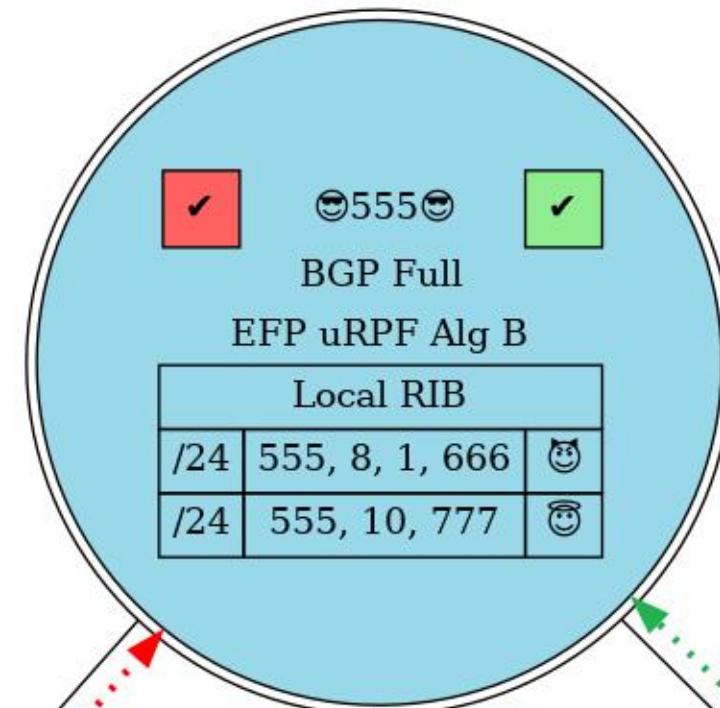
### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	1	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)

(Victim Outcomes)



(efp\_b\_000 Ground Truth)  
Three reflectors running EFP uRPF Alg B, one disconnected from both victim and attacker

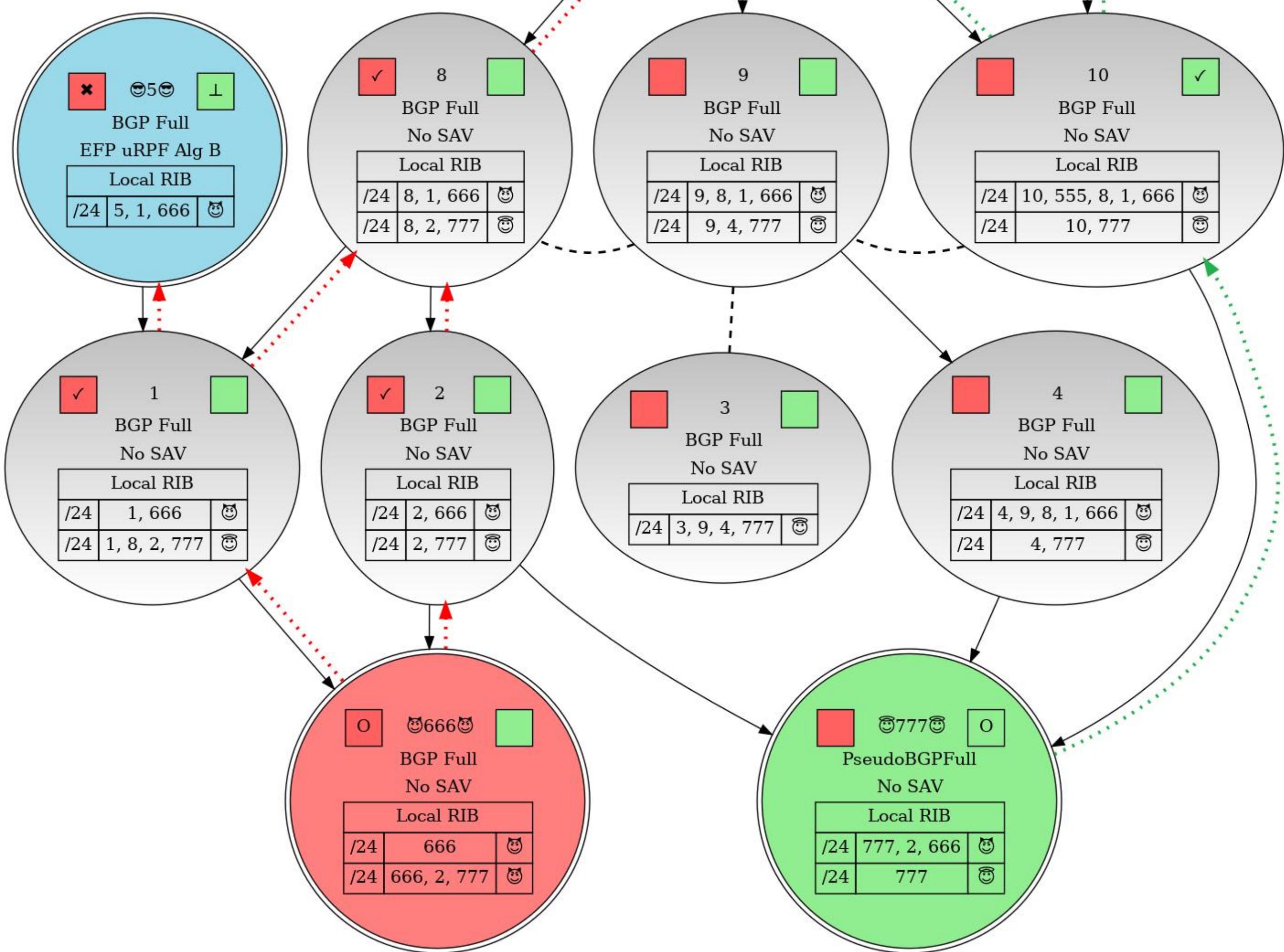
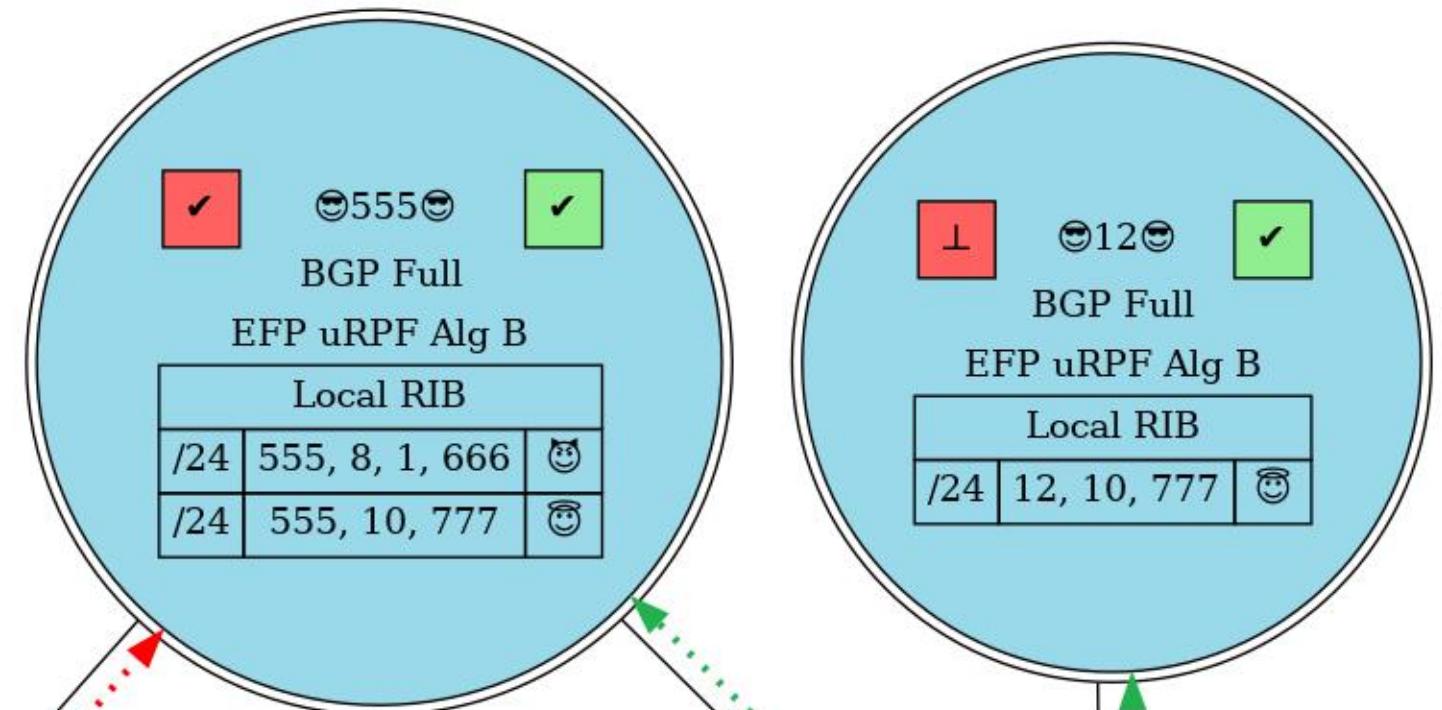
### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	1	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)

(Victim Outcomes)



(efp\_b\_000)

Three reflectors running EFP uRPF Alg B, one disconnected from both victim and attacker

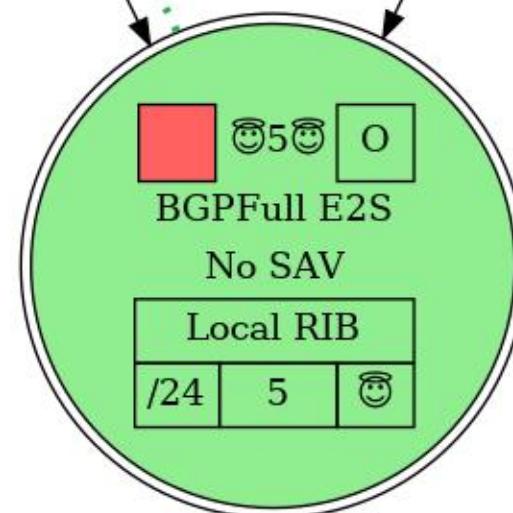
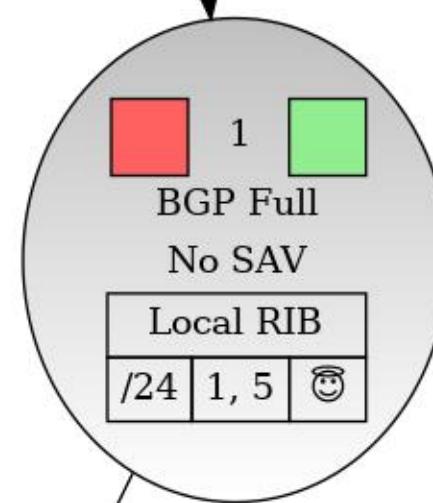
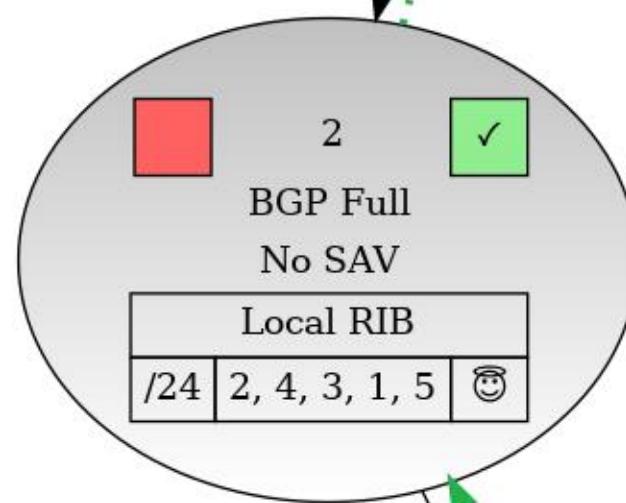
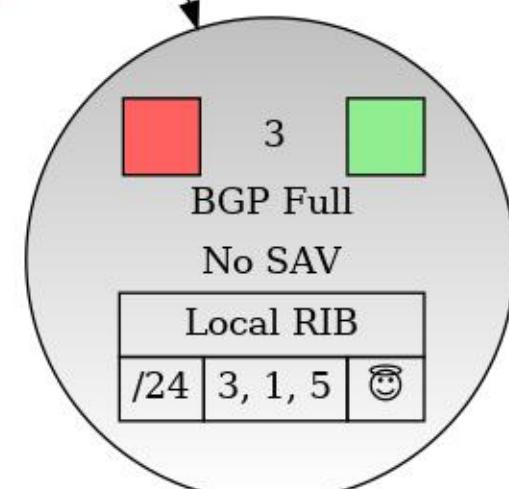
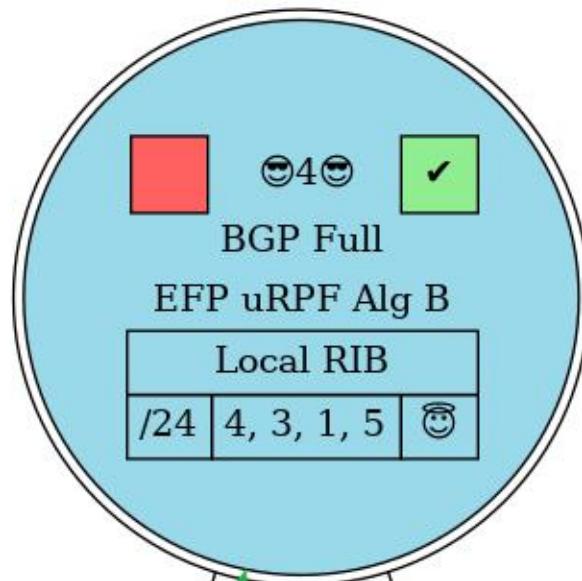
## (Data Plane Outcomes)

(Attacker Outcomes)

(Victim Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	1
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)



(efp\_b\_001 Ground Truth)  
Export 2 some passing for EFP Alg B (fails for Alg A)

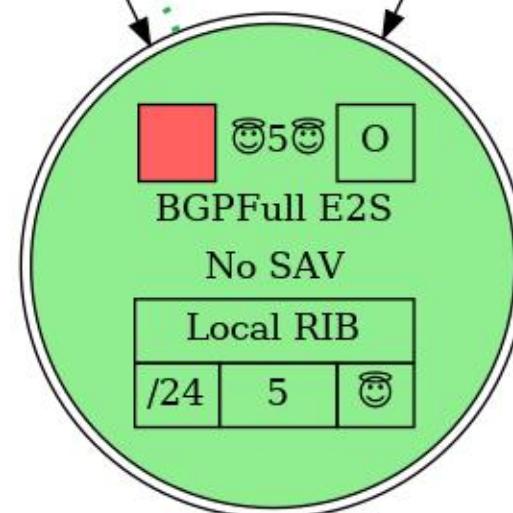
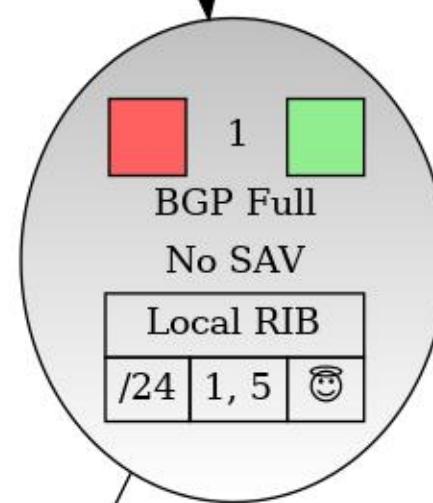
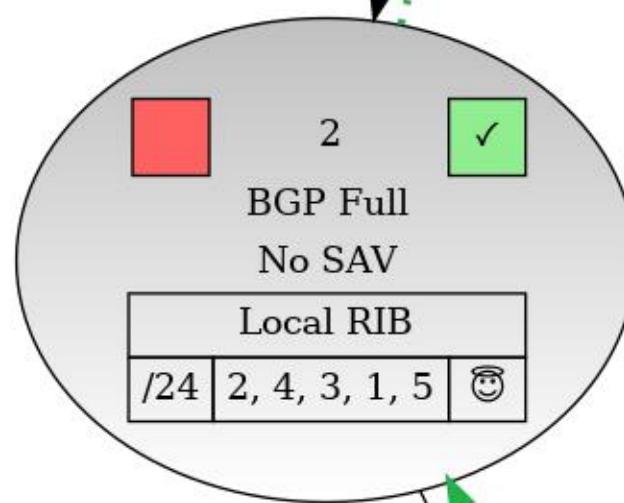
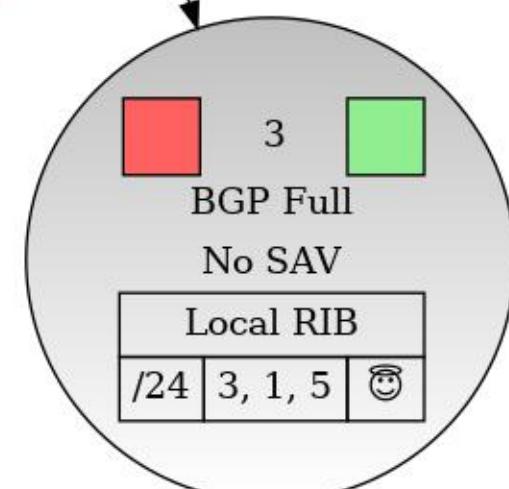
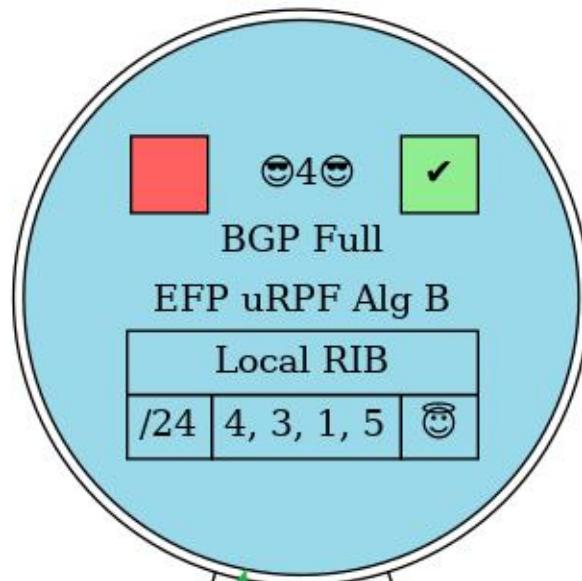
## (Data Plane Outcomes)

(Attacker Outcomes)

(Victim Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	1
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)



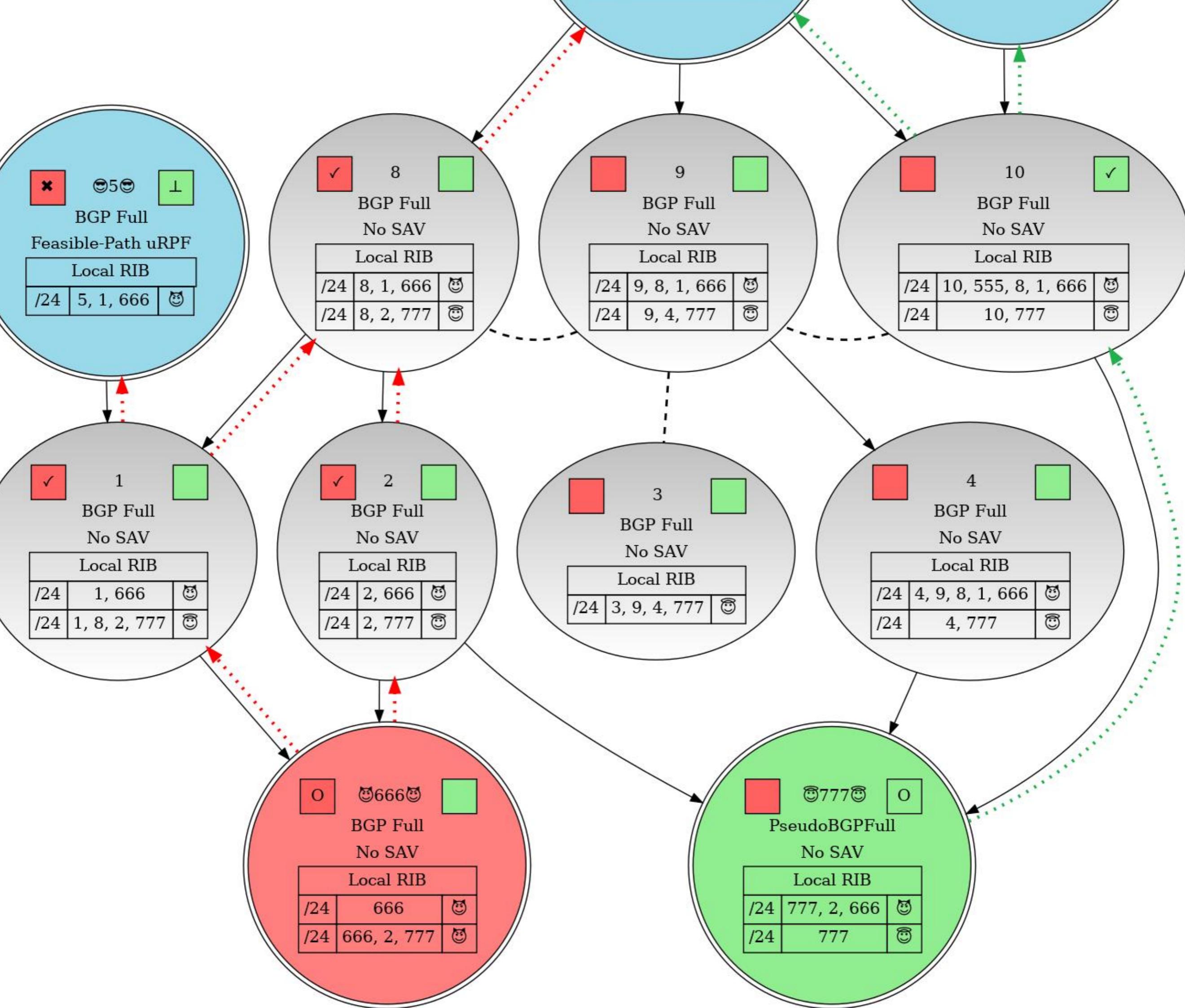
(efp\_b\_001)  
Export 2 some passing for EFP Alg B (fails for Alg A)

### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	1	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)



(fp\_000 Ground Truth)

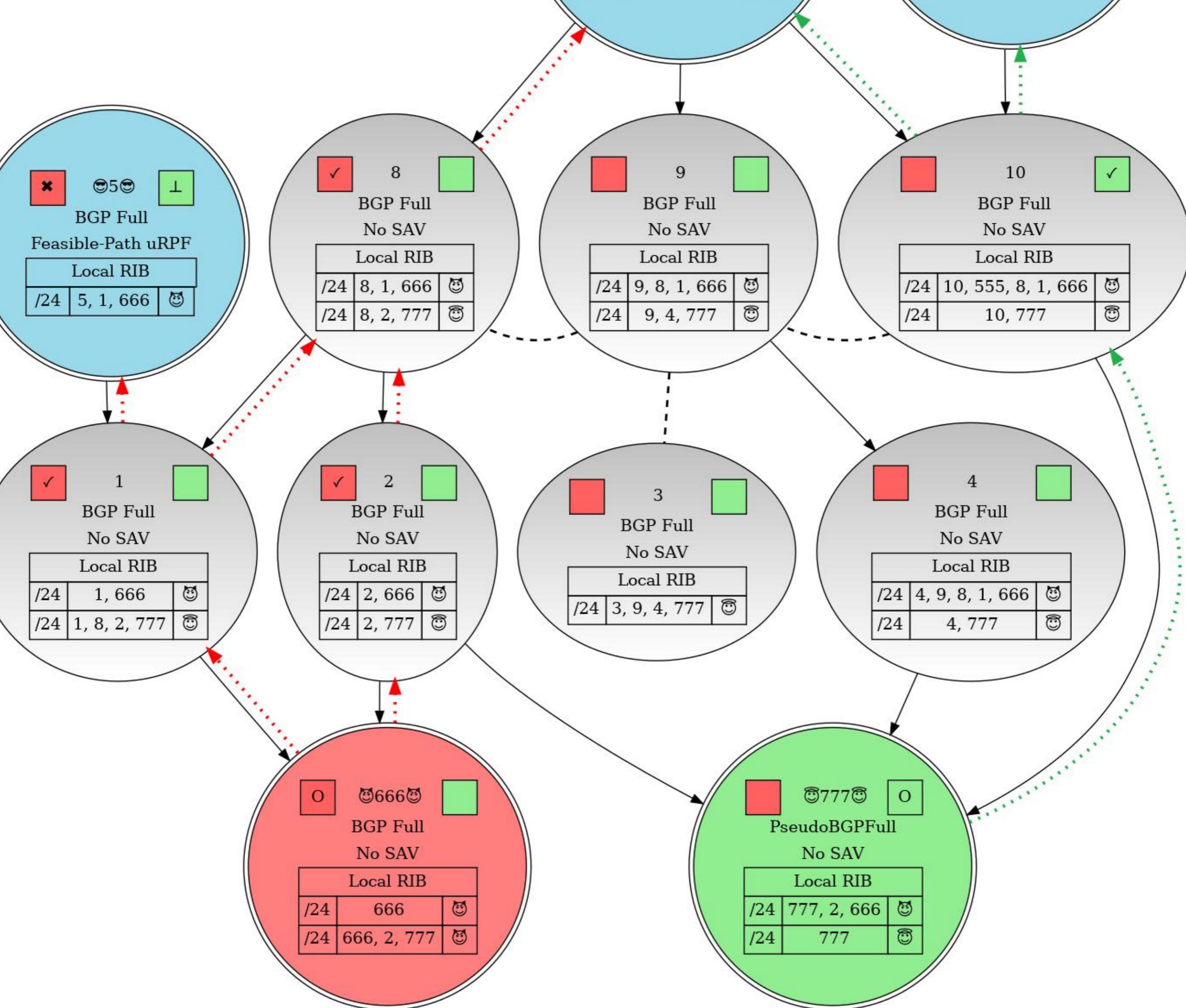
Three reflectors running Feasible Path uRPF, one disconnected from both victim and attacker

### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	1	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)



(fp\_000)

Three reflectors running Feasible Path uRPF, one disconnected from both victim and attacker

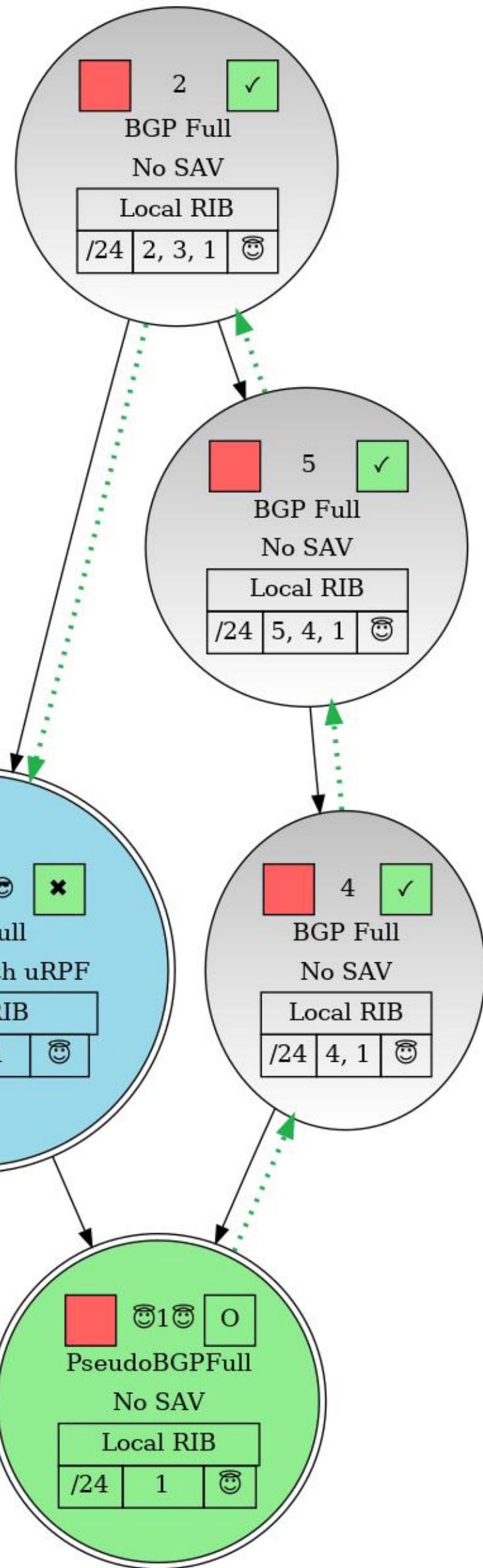
### (Data Plane Outcomes)

(Attacker Outcomes)

(Victim Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	0
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	1
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)



(fp\_004 Ground Truth)

False positive test for Feasible Path uRPF with Export-to-All

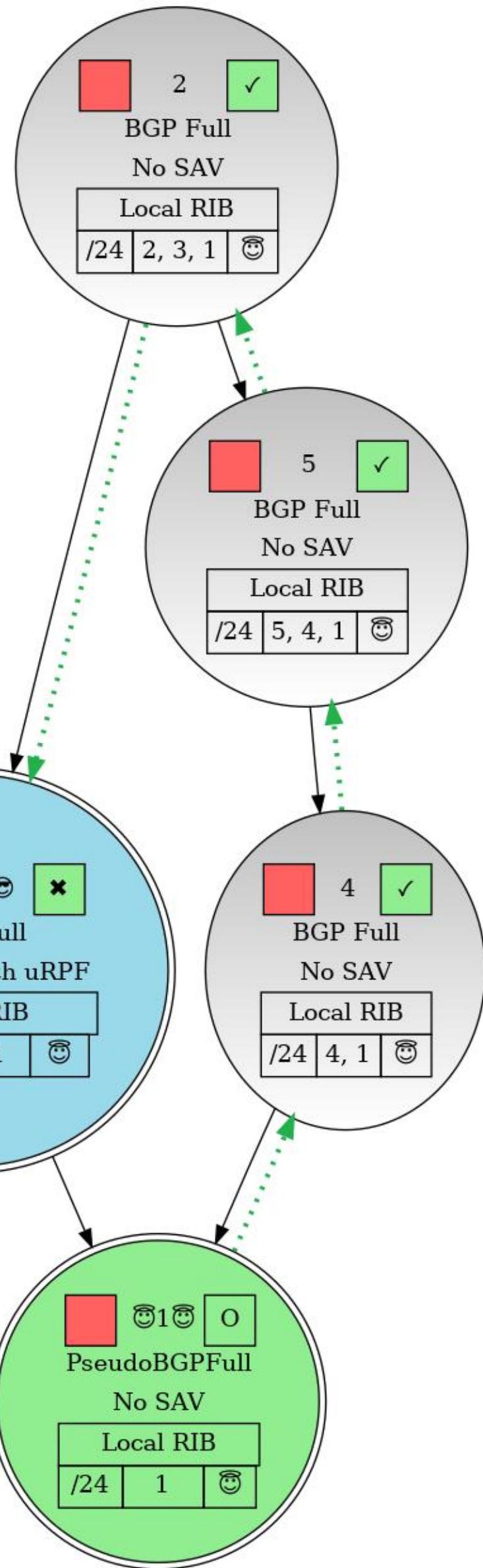
## (Data Plane Outcomes)

(Attacker Outcomes)

(Victim Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	0
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	1
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)



(fp\_004)

False positive test for Feasible Path uRPF with Export-to-All

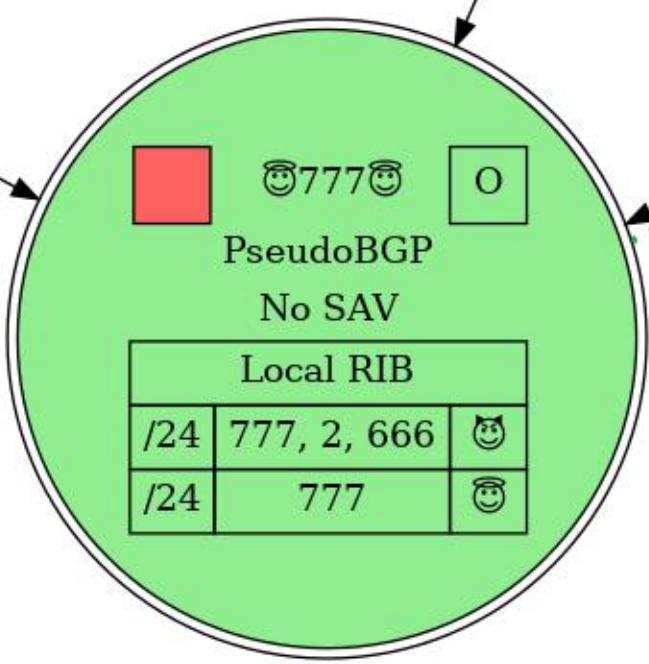
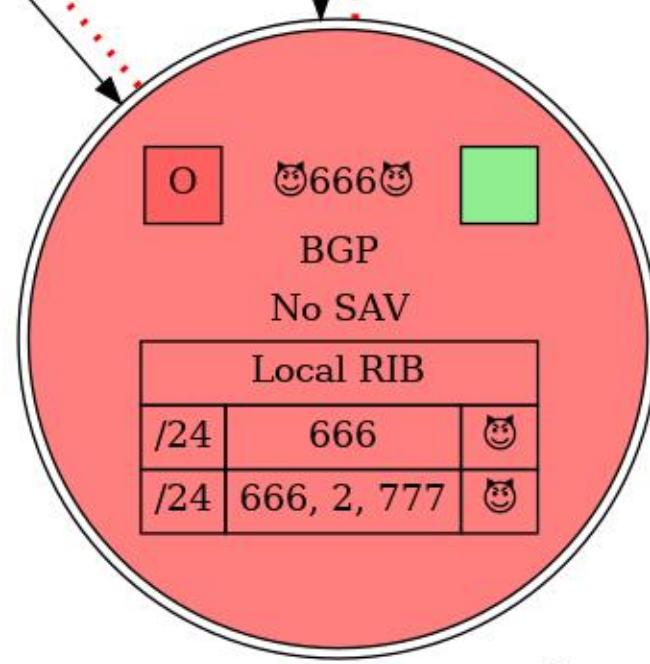
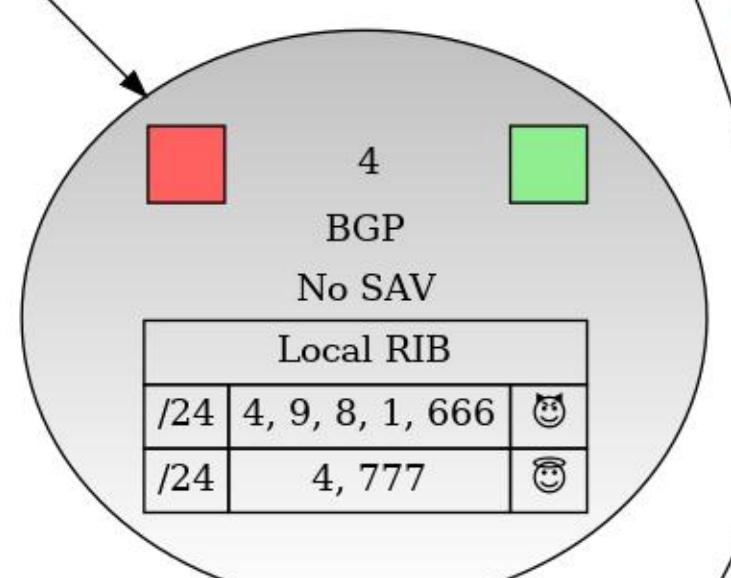
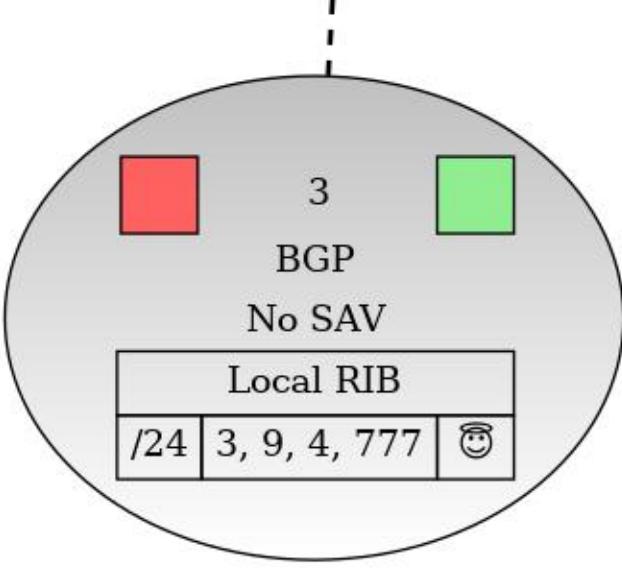
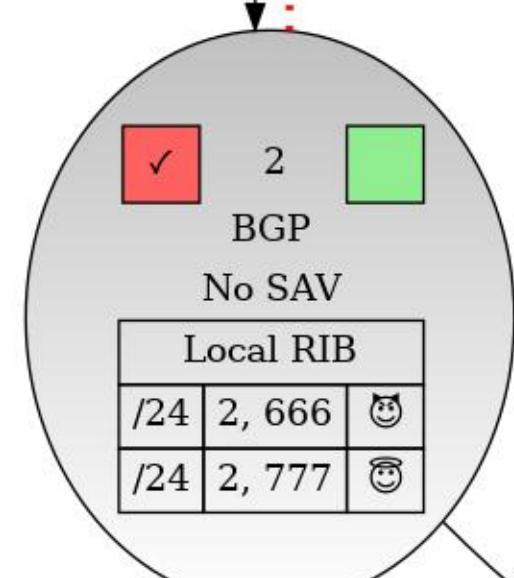
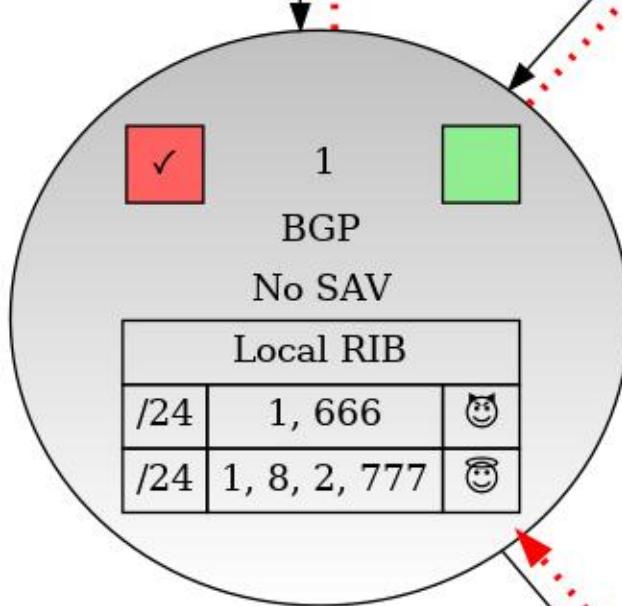
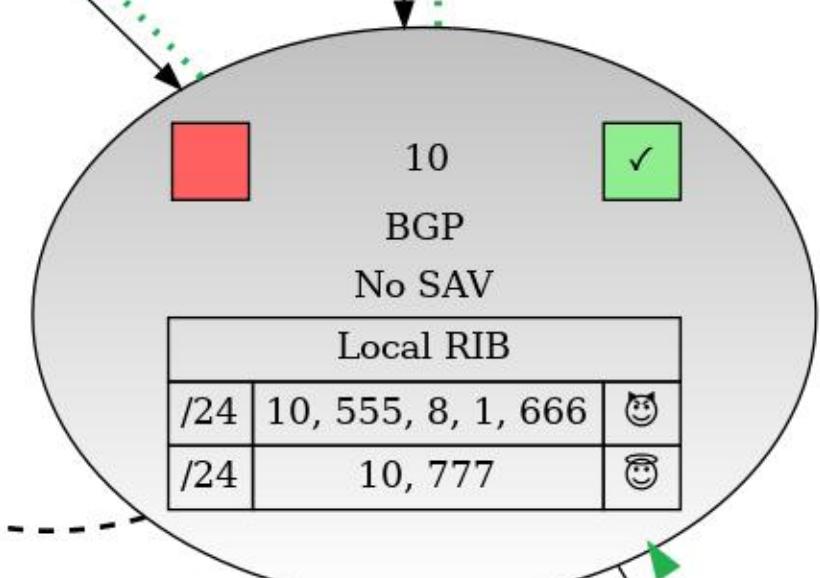
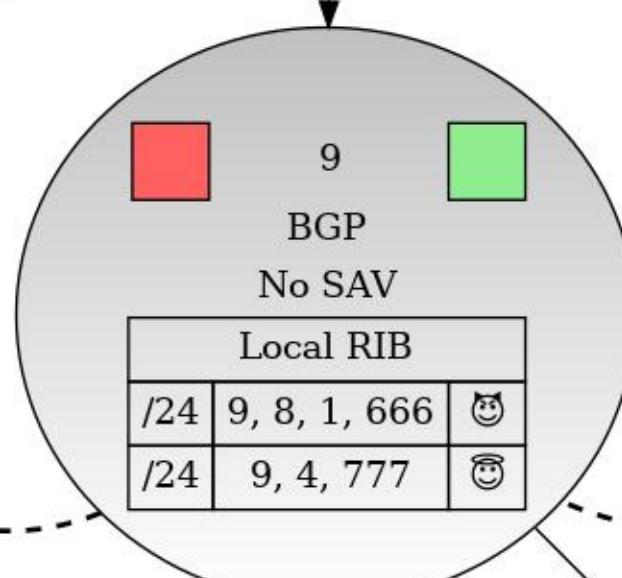
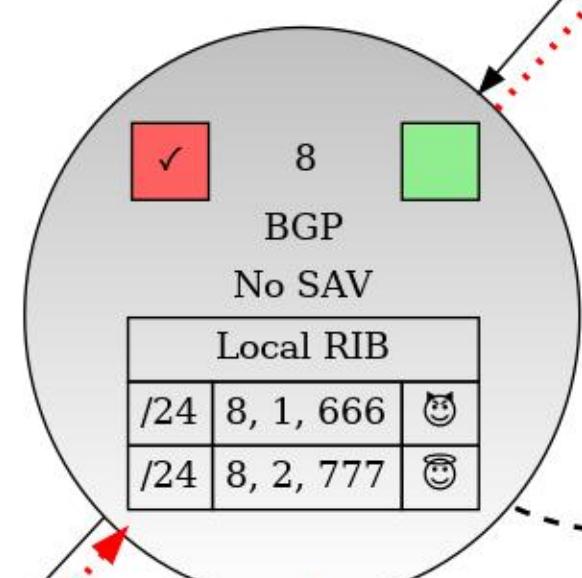
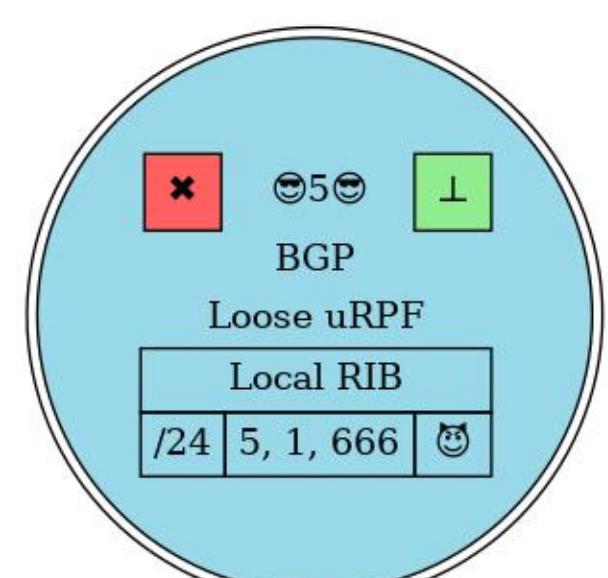
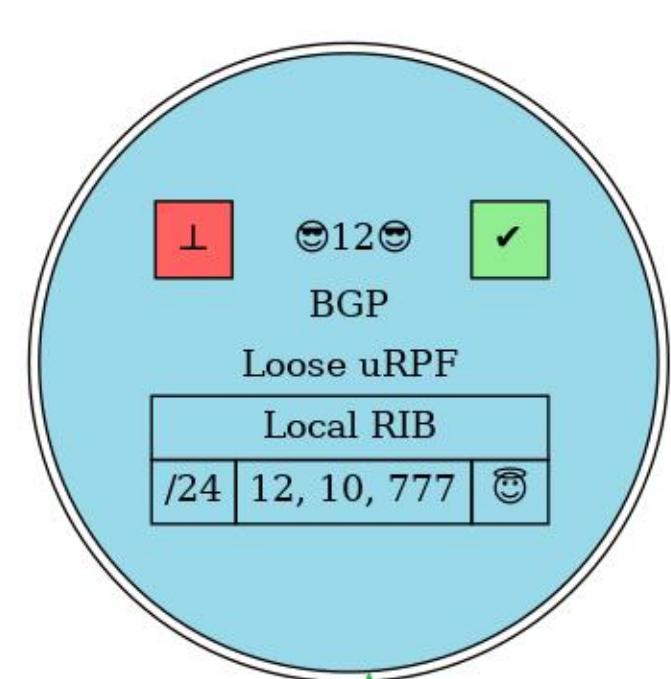
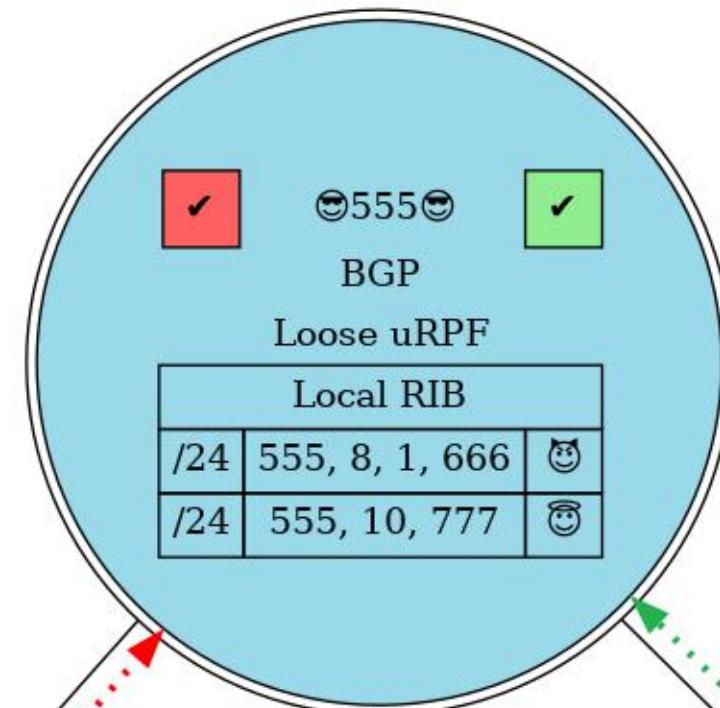
### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	1	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)

(Victim Outcomes)



(loose\_000 Ground Truth)

Three reflectors running Loose uRPF, one disconnected from both victim and attacker

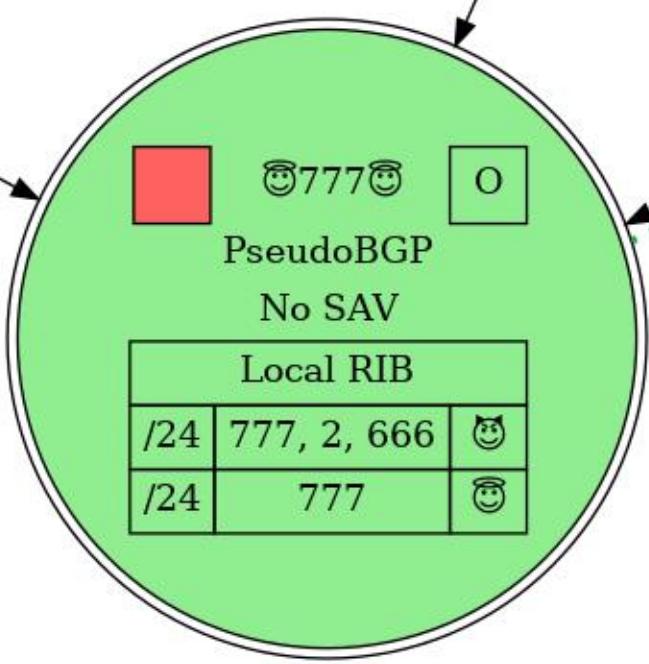
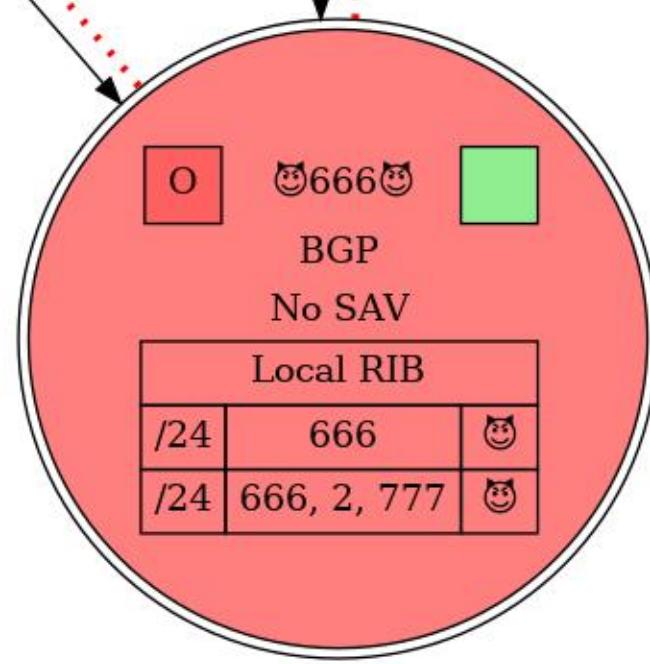
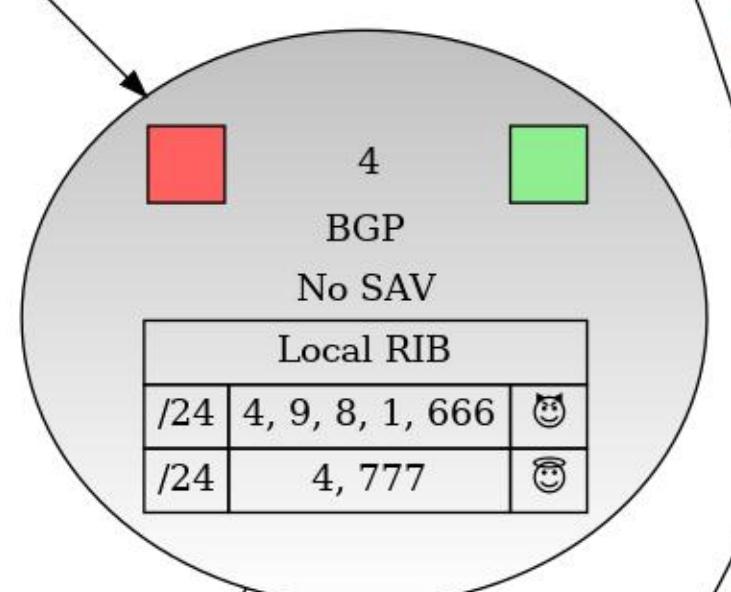
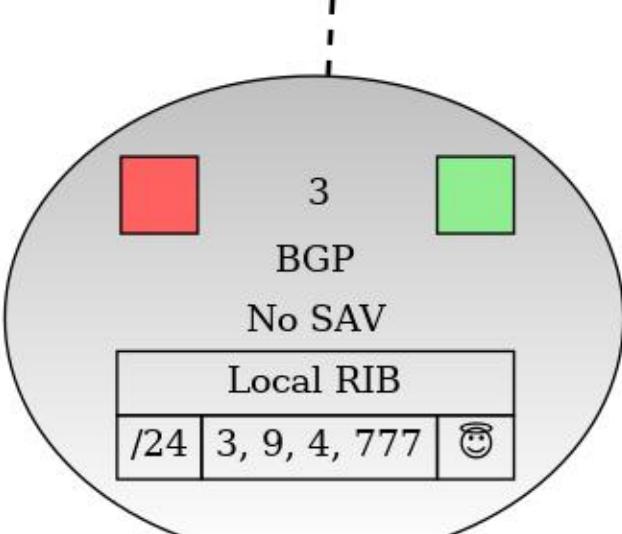
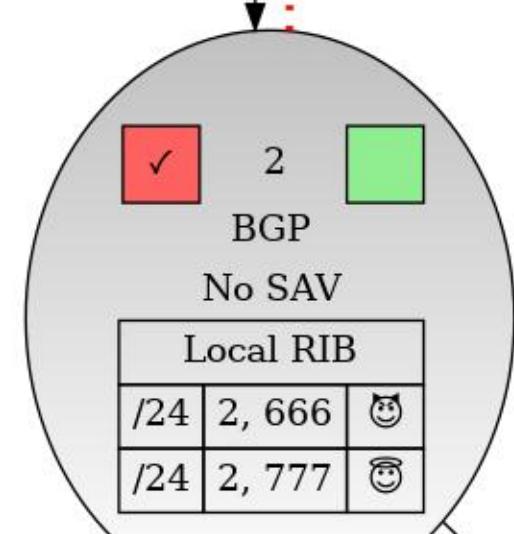
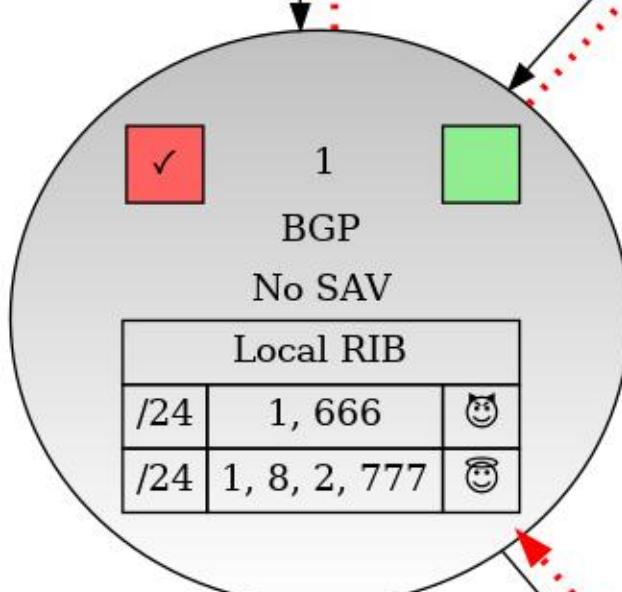
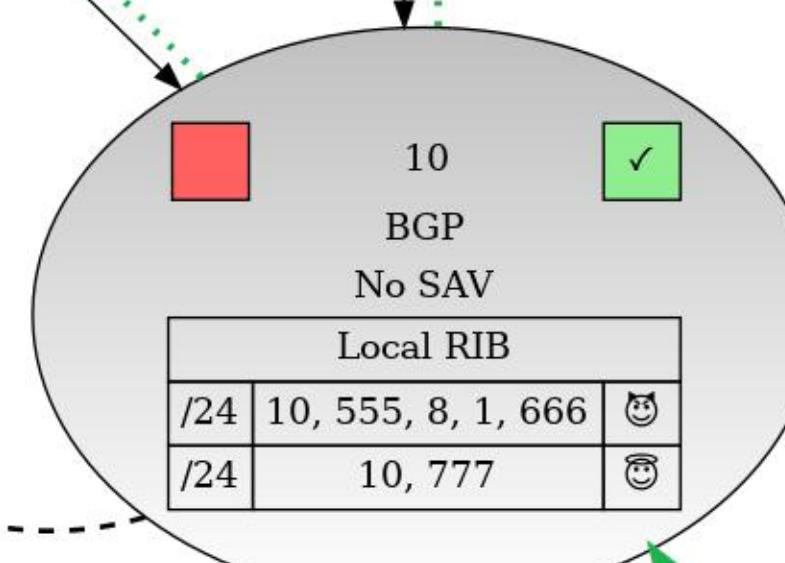
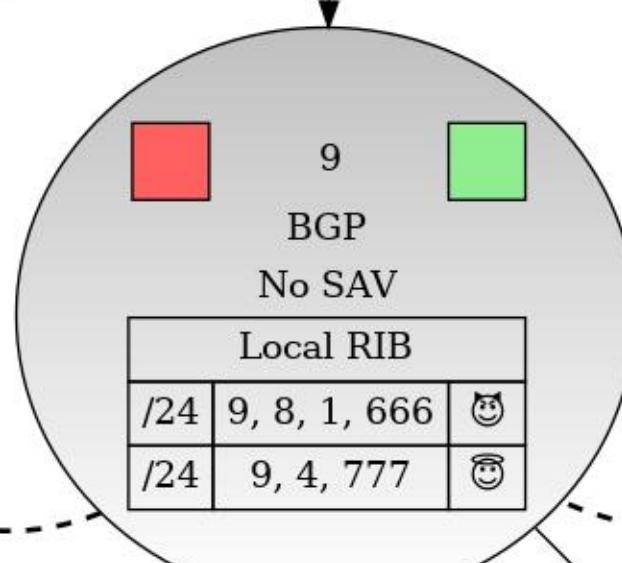
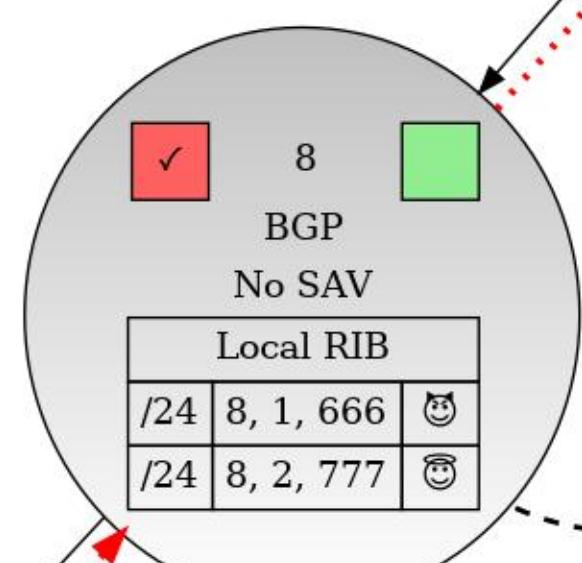
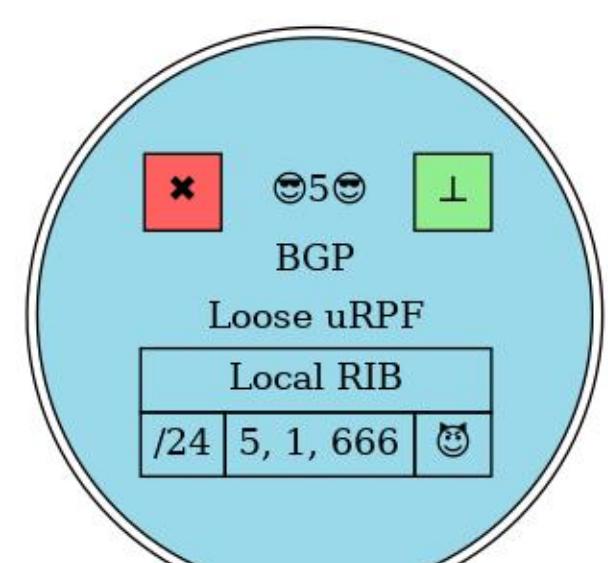
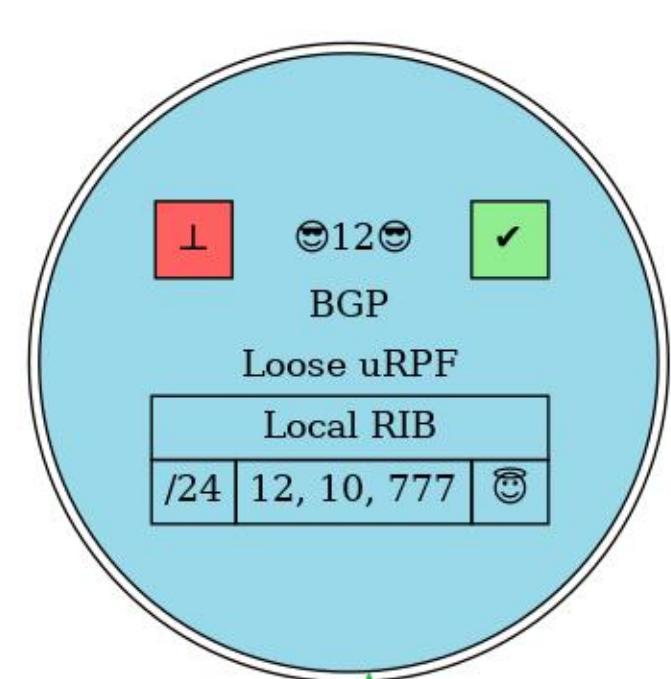
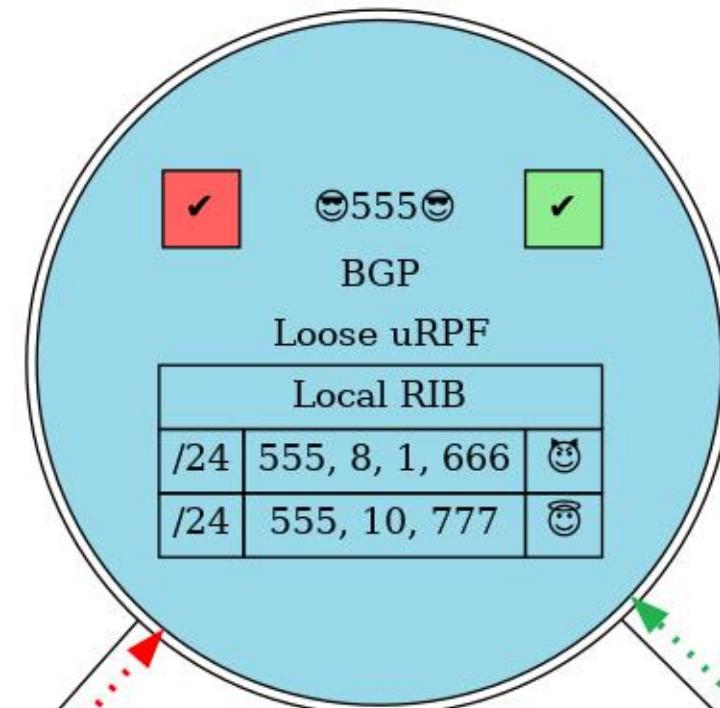
### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	1	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	1	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)

(Victim Outcomes)



(loose\_000)

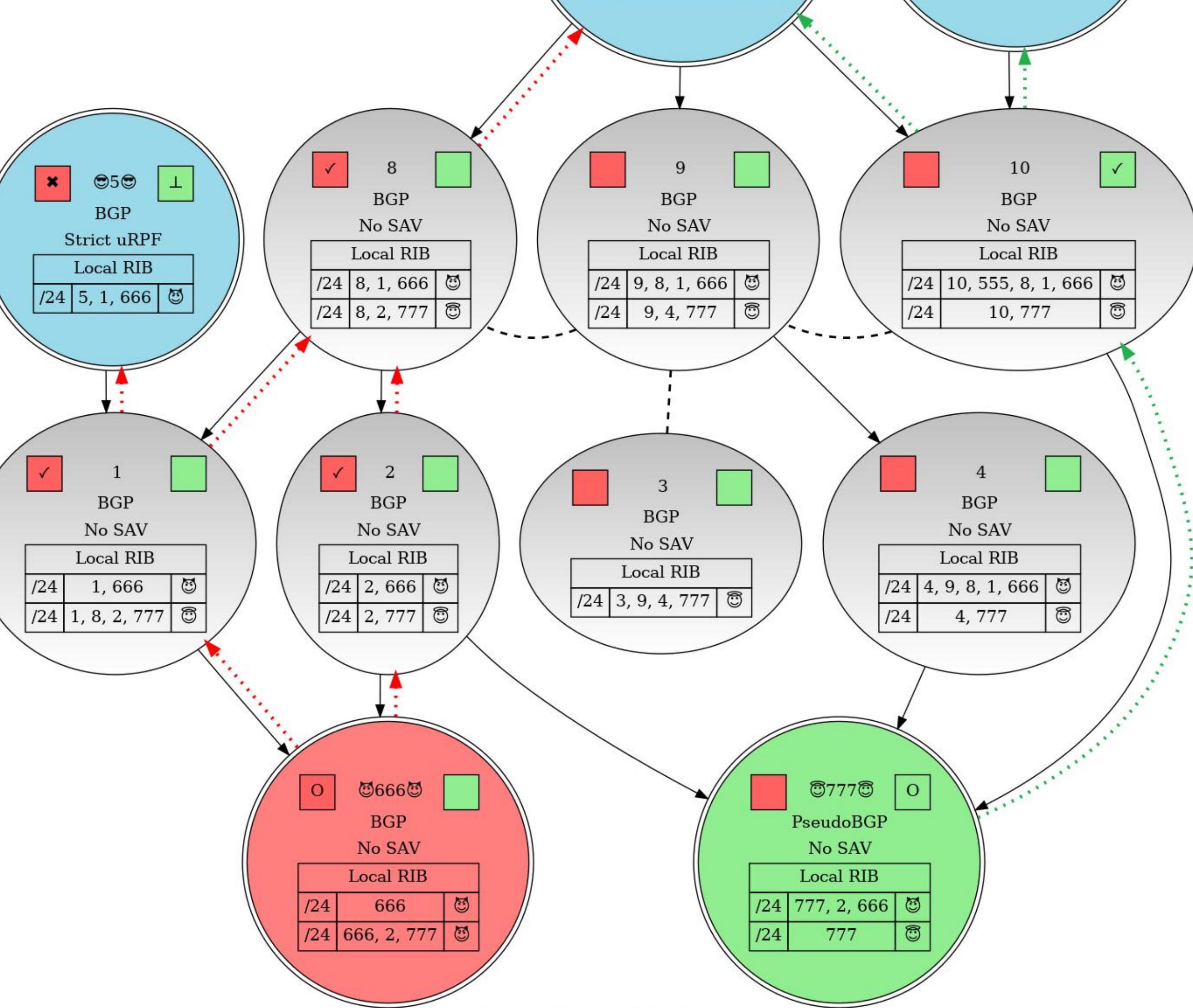
Three reflectors running Loose uRPF, one disconnected from both victim and attacker

### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	2	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)



(strict 000 Ground Truth)

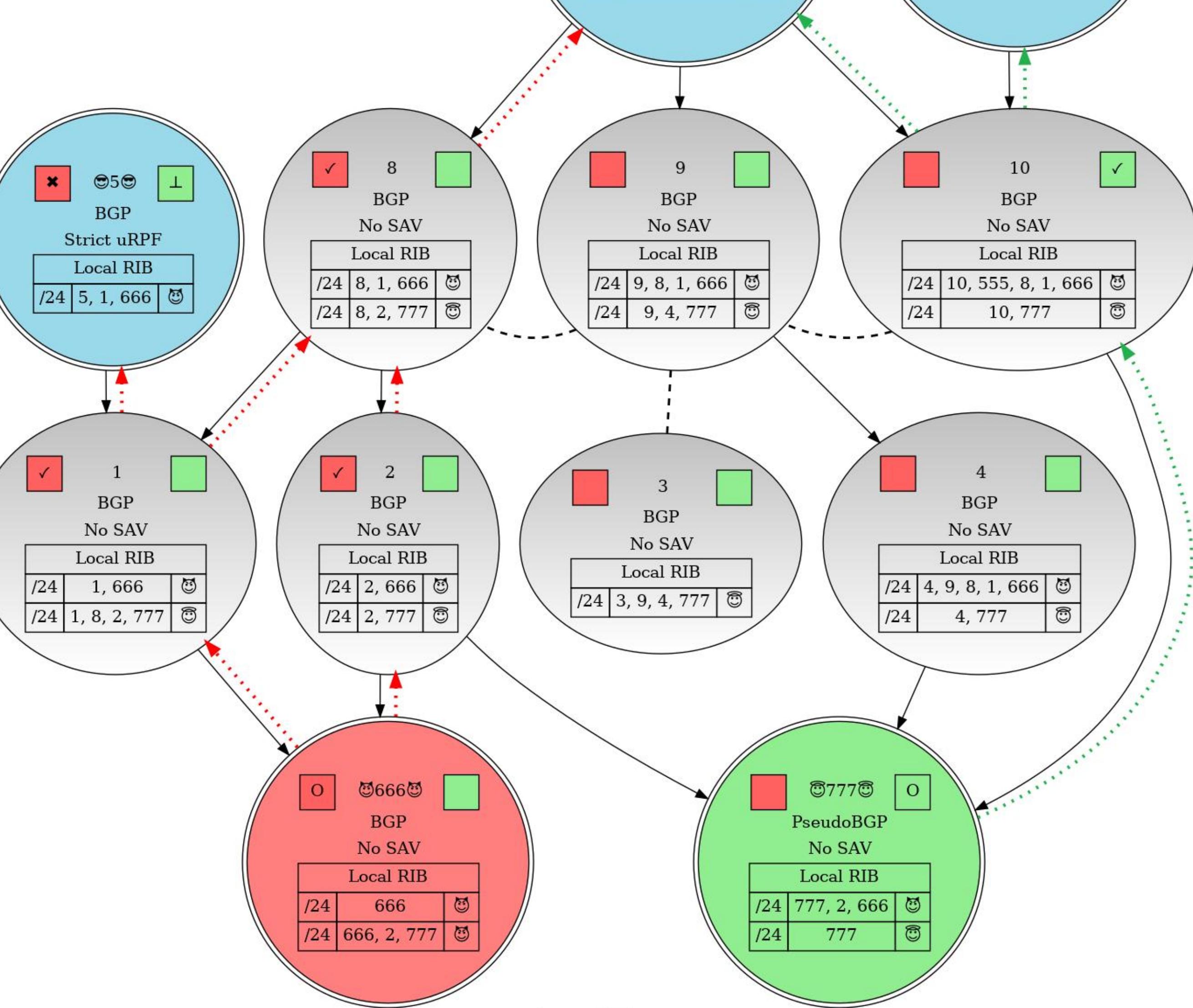
Three reflectors running Strict uRPF, one disconnected from both victim and attacker

### (Data Plane Outcomes)

(Attacker Outcomes)

✓ FALSE NEGATIVE ✓	0	✓ TRUE NEGATIVE ✓	2
✗ TRUE POSITIVE ✗	2	✗ FALSE POSITIVE ✗	0
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	0
⊥ DISCONNECTED ⊥	1	⊥ DISCONNECTED ⊥	1

ROAs (prefix, origin, max\_len)



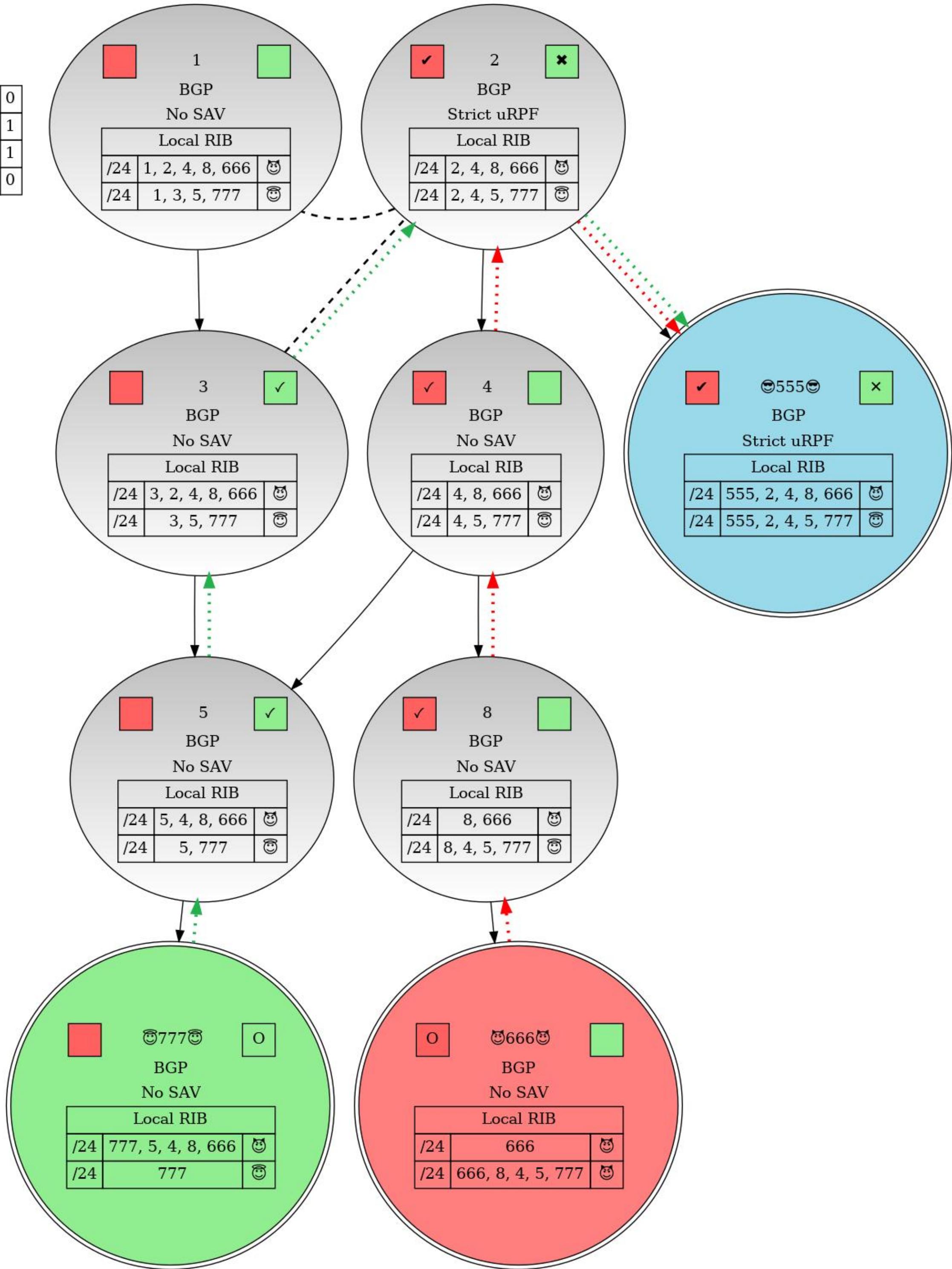
(strict\_000)

Three reflectors running Strict uRPF, one disconnected from both victim and attacker

### (Data Plane Outcomes)

(Attacker Outcomes)		(Victim Outcomes)	
✓ FALSE NEGATIVE ✓	2	✓ TRUE NEGATIVE ✓	0
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	1
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	1
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)

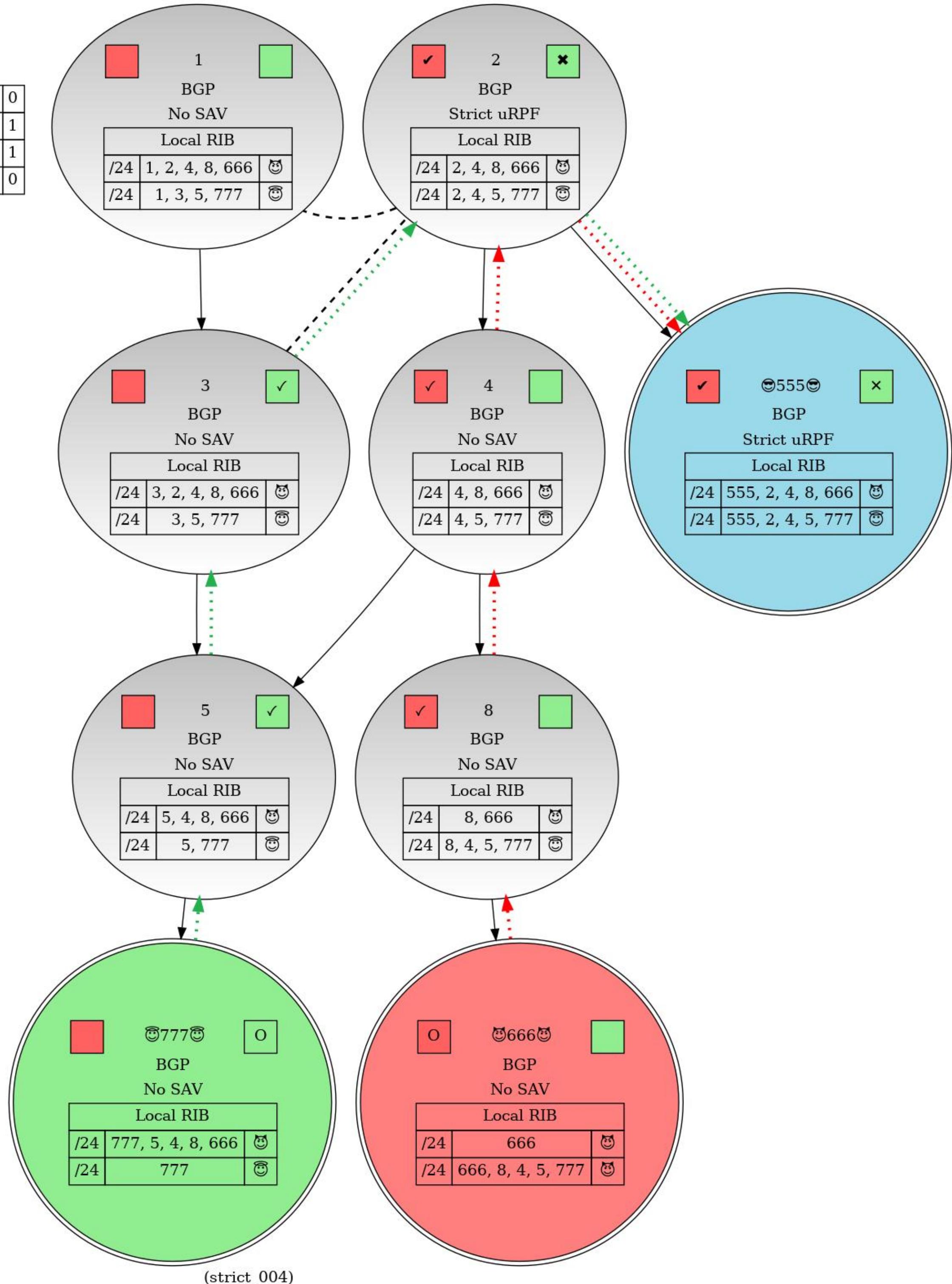


(strict\_004 Ground Truth)  
Strict uRPF on Asymmetric Route (Expecting False Positive)

### (Data Plane Outcomes)

(Attacker Outcomes)		(Victim Outcomes)	
✓ FALSE NEGATIVE ✓	2	✓ TRUE NEGATIVE ✓	0
✗ TRUE POSITIVE ✗	0	✗ FALSE POSITIVE ✗	1
✗ FILTERED ON PATH ✗	0	✗ FILTERED ON PATH ✗	1
⊥ DISCONNECTED ⊥	0	⊥ DISCONNECTED ⊥	0

ROAs (prefix, origin, max\_len)



(strict\_004)  
Strict uRPF on Asymmetric Route (Expecting False Positive)